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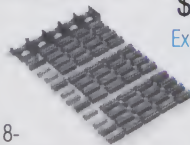
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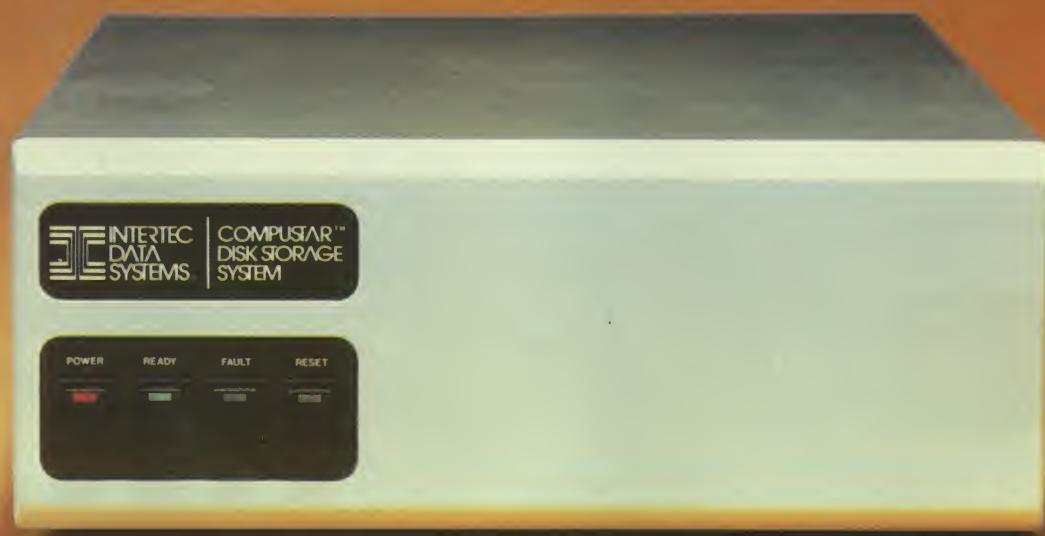
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This month:

Our March issue features part one of a comprehensive article on the Heathkit All-In-One Computer, the H-89. Beginning on page 28, H-89 owner Martin Moore describes his experiences in constructing the machine and getting it up and running. If you've been contemplating the purchase of an All-In-One, you'll appreciate his commentary. Next month's follow-up article will take a look at H-89 software.

Building your own computer wasn't always so easy. Of course, back in the Dark Ages (1975), the *only* way to acquire a working micro was to do it yourself. Even then, you could expect to spend weeks or months debugging the system before it performed properly. One of the reasons Wayne Green started *Kilobaud Microcomputing* was to help the early pioneers share fixes and tips.

When Heath Company's teaser ads first appeared in the summer of 1977, many of us waited with considerable interest to see what Benton Harbor had wrought. The H-8 was finally unveiled in the autumn, and some were disappointed that Heath had not selected the S-100 bus. Others disliked Heath's choice of split octal notation. Still, the H-8 *was* a Heathkit, which meant you had an excellent chance of assembling it successfully. Now in its fourth year, the H-8 is still a good value.

With the All-In-One, Heath has stepped squarely into that market segment dominated by Radio Shack, Apple and Commodore. More importantly, however, they've done this without denying H-89 owners the satisfaction of saying, "I built it myself!"

—The Editors

This month's cover:

The Heathkit H-89 All-In-One Computer.
Photo by Martin Paul.

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Built-in Computer Serviceman



Self Servicing

One of the things you discover when you computerize any business operation is that computers have a tendency to fail. The second thing you find out is that once the computer stops, your business stops, too. All your employees who were entering data are now on an extended coffee break. All the people who were filling orders generated by the computer are playing games. The office workers who had been word processing are gossiping. A computer breakdown in even a small business can cost you several hundred dollars an hour—plus the aggravation of trying to catch up again once it is back on line, and several hours of work have to be done on overtime.

To give you an idea of what can happen, let me draw upon my own bitter experience. We put in a Prime computer, complete with expensive environmental controls. But things do go wrong. An air conditioner may fail, increasing the temperature a few degrees and thus stopping the whole system for a day or two. We have to protect against heat, cold, dryness, wetness, static, and so forth, with tolerances far more exacting than you'll find in the average business office.

The Prime suddenly stopped working one day. Since we had a maintenance contract, we called the firm for service. The home plant is less than an hour's drive from us, so we expected fairly prompt service—hours, maybe, but a couple of days at the most. Several months later, the system was finally back in full working order.

While Radio Shack has been making some positive strides toward providing service for their systems, few other manufacturers have the sales or means to make quick service available.

For a computer to be of any real value to a business, it must work in an office environment, not be sealed in a scientific

lab with environmental controls. It should be able to work through chance power outages without faltering. And when something does go wrong, it should be repairable in minutes rather than hours.

There are several alternatives to providing this kind of service. One is to have traveling servicemen who can come to your office to fix the system. This is the system used by IBM, and it works fairly well. When one of my typewriters that is on service contract stops working, I know that I'll have it going within a day or two—except on weekends, which is when my typewriter usually stops. The serviceman has to be able to fix the system on the spot, which is not too difficult for typewriters, but might be more of a problem for computers, which may require sophisticated test equipment. The computer serviceman would probably need a van instead of a car.

In the old TV-repair system, a driver picked up the set, drove it to a service center for repairs and then returned it. This method solves the test equipment and test technician problem, providing more repairs per hour when the tech does not have to drive for an hour to the office site. But this means that your service centers will have to be set up no more than 100 miles apart if you are going to keep trips down to 50 miles or less—which is still at least a two-hour trip for each pickup and delivery. A 100-mile round trip is not going to be inexpensive, adding perhaps \$100 to the service call by the time you add in everything. This is not going to be popular.

Another alternative is to have the businessman bring in the computer for repairs. It will cost him a lot less to make that 50-mile trip, and he'll get it done quicker. The computer system is relatively light and easy to move, so this might be a viable alternative. However, since businesses are not used to this, it might not be easy to sell. Repairmen

come in to fix their typewriters, copiers and other office equipment, so there might be considerable resistance to having to bring the computer to the lab.

The computer is different from other office equipment in one important way. When a typewriter breaks down, there is no way that it is going to be able to fix itself, or even diagnose its own problems. The office copier, when it gets a piece of paper stuck in its gullet, will not respond to the Heimlich maneuver. It requires an expert to pull that wad out. The computer, on the other hand, can be built and programmed to take its own pulse and let you know what is ailing it.

Compugraphic was the first firm that I know of to figure this out. For a bit extra you can buy a service kit along with their computerized typesetter. Thus, when something goes wrong, you pull out the kit and start making simple tests. The kit has repair boards for you to replace if that is called for, and you then send the bumper in by UPS for replacement.

Microcomputers can be built for servicing, with simple-to-reach plug-in boards. Diagnostics that will check for memory errors, CPU problems, power supply problems, etc., can be included with the system. The important thing is to start building the servicing of our systems into the systems. In this way we will be able to provide a far more valuable office tool.

Our office computers should have protection against loss of power. This may come as a battery floating on the line to be used in case of emergency. It might only take the form of a large capacitor which would store enough energy to allow the system to quickly store work in progress for later retrieval.

Perhaps it will be possible for a system of remote diagnostics to be designed which can be done over the phone line via a modem. How service is done is not as important as the speed (high) and the costs (low). □

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Handy Utilities

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Pro-Kit #1

This utility package for the PET is a collection of machine code routines that can be permanently located in a protected area at the top of the PET's memory. Once installed, writing programs to accept information from the keyboard is as simple as using INPUT commands, but as safe as a GET routine involving the most comprehensive validation checks. The Pro-Kit routines are called by a few simple POKE and SYS commands. They can easily be incorporated into your own programs, and the authors (Intex Datalog Limited, Eaglescliffe Industrial Estate, Eaglescliffe, Stockton-on-Tees, Cleveland TS16 0PN England) are willing to negotiate terms for using their routines in programs offered for sale.

The simplest routine is the date input routine, which allows inputting a date in a standard format. Only valid dates are accepted; all other inputs are ignored by the routine. It checks for an invalid day for the particular month specified and even handles leap years correctly. The specific format required is a set of three pairs of two-digit numbers representing the day, month and year in that order. This routine is called by a SYS command and returns the date entered as a string in QS.

A general input routine allows you to specify the maximum length of the entry field and which of the printable characters are to be accepted as valid input. This routine is used for inputting any information that is not a date or a decimal number. To use the routine, you first define a string VCS that contains each character which the routine will allow as input. Then you poke location 1 with the maximum number of characters you want in the entry field. The routine is called by a SYS command, and the data entered from the keyboard appears in QS padded with trailing spaces if necessary.

For numeric input, another routine allows you to specify how many numbers you want before and after the decimal

point and whether or not negative numbers are allowed. Before calling this routine you must poke locations 910 and 911 with the number of digits before and after the decimal point. Then poke location 912 with a zero if only positive numbers are allowed, or with a one if positive and negative numbers are allowed. The routine is called by a SYS command, and the user's input value is returned as a properly formatted string in QS.

The number input routine has a default input value of zero. If you enter a number followed by a decimal point, pressing the decimal point immediately formats the integer part of the field in the proper position. If you enter a small integer number without pressing the decimal point before pressing RETURN, the value returned in QS may not be the correct value. This is due to the default characters displayed on the screen in the entry field area. This condition can be avoided by pressing the right-bracket (]) key instead of RETURN. This deletes all characters from the current cursor position to the end of the input field.

If you enter numbers right up to the decimal point, the next number entered automatically goes into the position after the decimal point without pressing the decimal point key. When no numbers are entered prior to the decimal point, QS is padded with spaces plus a leading zero. Negative numbers are indicated by pressing the minus sign at any time during the input before pressing RETURN.

Another useful routine allows searching a string in S2\$ for a matching substring specified in S1\$. A similar search in BASIC could take up to 2.5 seconds, but this routine is almost instantaneous. The routine is called by a SYS command after setting S1\$ and S2\$ to the appropriate values. Location 32767 then contains a number indicating the starting character position where a match was found in S2\$. If the value in 32767 is zero, no match was found.

This routine makes it simple to implement single-key mnemonic responses to

a menu without lots of "IF AS="XYZ" THEN..." statements. Instead, you just define S2\$="NSEWUD" (or whatever answers are valid) and use a GET statement to receive the option letter in S1\$. Then call the PROKIT routine via the correct SYS command and branch to the desired option by a simple "ON PEEK (32767) GOTO..." command.

For proper operation of the Pro-Kit routines, the PET must be in the upper/lowercase mode (POKE 59468,14). In this mode, a string in QS displayed in uppercase on the screen would appear as either graphics or lowercase on the printer. A graphics conversion routine, called by the proper SYS command, will convert the contents of QS to the proper format for being printed as it would appear on the screen.

In all Pro-Kit entry routines, as RETURN is pressed the entry field changes from reverse to normal and a thin line (|) is placed to the right of the entry field. The input routines assume that your entry fields are normally shown with a surrounding box formed using the family of shifted @|123+0 characters.

Another function common to all Pro-Kit entry routines is the action caused by pressing the RVS key instead of RETURN. This acts just like a RETURN, but location 32767 is set to a one instead of a zero. The appearance of a one in this location can then be used as an indication that something special should happen in the program after the entry is made. For example, it could mean to step back to the previous input instead of continuing to the next expected input.

Another three routines provide various screen-exchange functions. One routine takes whatever is displayed on the screen and dumps it in a specified area of memory. The second does the reverse, bringing back an area of memory to be displayed on the screen. The last routine exchanges an area of memory with the screen display. Before calling this routine by the SYS command, you must poke six memory locations. Two locations specify

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the start of the memory area to be used while the other four locations determine which of the three screen exchange functions is to be performed. It is the user's responsibility to change the BASIC top-of-memory pointers to protect a suitable area of memory for the desired application.

The Pro-Kit routines can be easily incorporated into your own programs. However, the suggested method of saving a program with Pro-Kit is to save all RAM using the monitor. Thus, each program will be 32K long and take about 125 blocks on disk. You can save just the program as normal without Pro-Kit, but then you have to load Pro-Kit separately each time the program is loaded.

This package of routines is handy and very impressive, but the assumed formats may or may not be what you would

like. The printed documentation is clear and complete, with various exercises to explain the operation of each routine. The programs are available on disk or cassette with additional demo programs included. They're all written for the 3032 PET (a 2001 with BASIC 3.0) and will not run with the BASIC 4.0 ROMs or on the 8016/8032 machines.

Utility Programs

I recently received a collection of various utility programs for review from California Software Associates (Box 969, Laguna Beach, CA 92652). I've included information on two of the programs I was able to try.

EDIT is a BASIC program that allows editing or appending to sequential or user diskette files on the 2040 disk. The edit function acts on files in place on the diskette, so records are limited to the original record length. When appending records to an existing file, the new records are limited to 80 characters per record. In either mode, colons and commas are ignored.

When the program is run you are asked for the desired filename and the disk drive number. The program then locates and traces the file chaining on the disk by track and sector. The number of blocks in the file and the number of free blocks on the disk are both displayed. For large files this can take some time (3.5 minutes, worst case), but it only occurs once. All following actions should be virtually instantaneous.

After all the initial setup is complete, you are asked whether you want to EDIT, APPEND or STOP. If you accidentally choose STOP, a RETURN will reenter the program. When you select EDIT you're asked for the record number to be edited. You can enter the exact record number, an exclamation point or RETURN to exit edit mode.

After entering a record number between one and the maximum record number, the program displays the current contents of the record with an up-arrow under the first character position. Once you position the up-arrow to the appropriate starting position, you simply type in the desired edit. Inserts into a full record delete any trailing characters, while deletes append trailing spaces. If you try to type beyond the end of the record, the last character of the record equals the last character typed. There is no wrap-around, and you cannot change the size of the record. When satisfied with the changes, hitting RETURN causes the new record to replace the original record in the file.

If you respond to the edit record number prompt with an exclamation mark, you are then asked for a search string of up to 80 characters in length. Leading question marks in your search string

function as "don't care" or "wild card" characters. No character matching is performed in these positions. A sequential search of the file is performed, looking for a match but only up to the length of the search string specified. Any trailing characters in the file record are ignored.

If the search is successful, editing proceeds as outlined previously. Otherwise, if the search fails, you will be asked again for an edit record number. Searching through long files can be rather slow. If you know about where the record is, using several record number guesses is much faster.

When appending new records, you are prompted for each new record with a maximum length of 80 characters. The delete key functions as normal while the cursor movement keys are disabled. You can add records to the limit of the block availability on the diskette. The appended records can later be edited, but they cannot be deleted once entered.

SNAPSHOT is a machine-language screen utility program that allows saving and restoring up to ten different copies of the CRT display. On the 2001 series PETs the program occupies the first and second cassette buffers, so neither cassette may be used while it is in place. It is normally compatible with BASIC as well as most other utilities such as WEDGE/DOS, TOOLKIT, EXTRAMON, etc. The program will usually notify you and abort if there is a utility in place with which it is not compatible. Various versions are available for each model PET/CBM and for the different ROM sets.

SNAPSHOT is loaded and run after all other utilities are loaded. It first asks for the maximum number of pages to be saved. If there isn't enough memory available, an error message is displayed and you get to try a smaller number. Otherwise, the program initializes itself and displays the number of bytes remaining for BASIC along with simple calling procedures for the program.

SNAPSHOT can only be called from the upper-left corner, or cursor-home position, of the screen. The first character in the call must be either an exclamation mark or an equal sign. The second character must be an allowable page number or an "X" (to deactivate SNAPSHOT). Each call is terminated with a RETURN, and any other data on the first line is ignored. An exclamation mark is used to copy the current screen contents to the section of RAM reserved for the indicated page number. An equal sign is used to recall a snapshot of the screen. The section of RAM reserved for the indicated page number is copied back to the screen.

Any SNAPSHOT call leaves the cursor in the cursor-home position so you can easily cycle through current snapshots of the screen. Once a snapshot has been taken, control is returned to BASIC command mode in the same condition as prior to the SNAPSHOT call. Thus, im-

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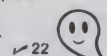
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mediate commands can be executed, programs run or continued, etc.

Although SNAPSHOT saves and recalls images of the PET screen, it does not save any line-wrapping (linking) information when the snapshot is taken. Similarly, SNAPSHOT does not change the line wrapping (linking) in effect before a snapshot is recalled. This can cause unpredictable or undesirable results if certain precautions are not taken if you intend to use any snapshot line as an immediate BASIC command or a program line. When SNAPSHOT is deactivated by an "IX" call, the BASIC CHRGOT routine and the IRQ vector in low memory are restored to the BASIC cold-start condition. This may deactivate other utilities, but BASIC is left untouched.

I found both programs to be very handy and encountered no problems with either. The EDIT program can be purchased separately for \$60 or as part of a complete disk utility package for \$100. The utility package also includes:

MESSAGE—which allows editing disk blocks, updating the disk block availability map (BAM), scanning files, mapping the disk, tracing block linkage, etc.

RECOVER—which recovers scratched files.

SNAPSHOT sells for \$25, and there are different versions for the various models and ROM sets as mentioned. On all programs sold by California Software Associates, there is an update service available.

Word Pro Disk Files

With the many valuable features of Word Pro, it's not surprising that more and more programs are using Word Pro to create input data or utilize their output data. In fact, there's no real reason why your own programs can't interface to Word Pro as well. It's really quite simple once you know the disk file format and character set used by Word Pro.

All disk files saved or read by Word Pro are actually program files with a load address as the first two bytes of the file. With Word Pro 3 the actual address is 5108 hex and is stored in the normal 6502 address format (low byte first—08; high byte last—51). The file then contains the actual text with any embedded control commands stored exactly as displayed on the screen. Each line is stored as 40 bytes regardless of its contents; there is no compacting of the data. If the only thing on the line was a RETURN (stored as a back-arrow), it would be stored as the RETURN followed by 39 spaces. If you are using Word Pro 4, then remember that there will be 80 characters per line instead of 40.

Now for the tricky part! The value stored for each character in the file is the same value as used in the screen RAM when the PET is in the upper/lowercase

mode (POKE 59468,14). These are the same values you would normally use when poking values directly into the display. Remember that the value used to generate a specific character can be different depending on the character set that is active—upper/lowercase or uppercase graphics. Since Word Pro 3 forces the upper/lowercase mode, we'll only be concerned with that character set.

Since Word Pro uses the OFF/RVS key to enter control mode, you cannot generate reverse characters. This limits the character set used by Word Pro to only 128 characters. There are really only 123 usable characters, since five characters are reserved for special purposes (RETURN, begin/end underline or enhance, tab, toggle uppercase lock). Table 1 shows the decimal and hex value of each character as stored/read by Word Pro.

If you want to read a file created by Word Pro (or by another program in Word Pro format), simply open the file as a sequential read file (OPEN 1,8,1,"O:filename,S,R). Read and ignore the first two characters, which represent the load address for the program file. Then read the data using a GET#1,CS (or similar) command and translate the data into the normal character set if necessary.

To write a file for Word Pro or in the Word Pro format, first open the file (OPEN 1,8,1,"O:filename,P,W). Now write the normal Word Pro load address: PRINT #1,CHR\$(8);CHR\$(81); followed by any

desired data. Remember to write the correct value for each character and always use the ending semicolon on the print statement. This will write individual bytes of data in the format desired.

Miscellany

Espon's new MX-80 printer offers a multitude of features normally unexpected in a low-cost printer. With an available IEEE-488 interface and an optional graphics ROM, it can easily be used with the PET. If you should decide to buy an MX-80, however, be sure you get the correct interface module. There were apparently two IEEE-488 interface boards—a model 8160 and an 8161. Only the 8161 board will work correctly with Word Pro. The original 8160 board will not handle all PET printing modes correctly.

If your company or organization is offering products of interest to PET/CBM owners, I'll be happy to review them here as space permits. Reviews are generally done in the order received. If you'd like something reviewed and timed to appear with a product announcement, please remember the typical three-month lead time for this column. As always, any and all correspondence is welcomed but should be addressed to me at my home address (15 Windsor Drive, Atco, NJ 08004). An SASE is appreciated if you expect a response. □

Dec	Hex	Char	**	Dec	Hex	Char	**	Dec	Hex	Char	**	Dec	Hex	Char
0	00	@		32	20	space		64	40	shift-@		96	60	shift-~
1	01	a		33	21	!		65	41	A		97	61	!
2	02	b		34	22	"		66	42	B		98	62	"
3	03	c		35	23	#		67	43	C		99	63	#
4	04	d		36	24	\$		68	44	D		100	64	\$
5	05	e		37	25	%		69	45	E		101	65	%
6	06	f		38	26	&		70	46	F		102	66	&
7	07	g		39	27	'		71	47	G		103	67	'
8	08	h		40	28	(		72	48	H		104	68	(
9	09	i		41	29	)		73	49	I		105	69)
10	0A	j		42	2A	*		74	4A	J		106	6A	*
11	0B	k		43	2B	+		75	4B	K		107	6B	+
12	0C	l		44	2C	,		76	4C	L		108	6C	shift-,
13	0D	m		45	2D	-		77	4D	M		109	6D	-
14	0E	n		46	2E	.		78	4E	N		110	6E	.
15	0F	o		47	2F	/		79	4F	O		111	6F	shift-/
16	10	p		48	30	0		80	50	P		112	70	0
17	11	q		49	31	1		81	51	Q		113	71	1
18	12	r		50	32	2		82	52	R		114	72	2
19	13	s		51	33	3		83	53	S		115	73	3
20	14	t		52	34	4		84	54	T		116	74	4
21	15	u		53	35	5		85	55	U		117	75	5
22	16	v		54	36	6		86	56	V		118	76	6
23	17	w		55	37	7		87	57	W		119	77	7
24	18	x		56	38	8		88	58	X		120	78	8
25	19	y		57	39	9		89	59	Y		121	79	9
26	1A	z		58	3A	:		90	5A	Z		122	7A	(wp-cmd)
27	1B	[		59	3B	;		91	5B	+		123	7B	shift-;
28	1C	(up-case)		60	3C	<		92	5C	=		124	7C	(beg-ul)
29	1D	]		61	3D	=		93	5D	!		125	7D	!
30	1E	|		62	3E	>		94	5E	@		126	7E	(end-ul)
31	1F	(tab)		63	3F	?		95	5F	shift-?		127	7F	@

Table 1. Decimal and hex values of Word Pro characters. The commands are indicated by a value of 122 (7A hex) in the first column of any display line. The command then follows with each character in the command as shown in the table. The uppercase lock is enabled/disabled by the value of 28 (1C hex). A value of 31 (1F hex) indicates a tab. The values of 124 (7C hex) and 126 (7E hex) begin and end underlining or enhancing, respectively.

First Impressions Are Forever

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First-Day Success

First impressions are important whenever you meet someone. First impressions are also important whenever someone meets a computer. Every effort should be made to make the first few experiences of the new computer user enjoyable. An enjoyable, successful first experience for students can go a long way toward making their future attitude regarding computer use a positive one. A successful first experience for teachers is almost a necessity if you want them to continue to explore the educational potential and reality of microcomputers in their classrooms.

During the late 60s and early 70s many interested, capable teachers were nearly, if not completely, convinced that computers could have little impact on classroom activities. These teachers had heard about time-sharing terminals connected to minicomputers and perhaps

seen a few enticing demonstrations. Their curiosity was aroused, so they enrolled in an introductory computing course in a local college or university.

That was the beginning of their decline. Many were taught to keypunch in preparation for batch processing. After all, the local college didn't yet have time-sharing terminals, "but the principles are all the same." Many others were taught FORTRAN, COBOL or RPG, because that's what the local college staff was prepared to teach. And still others were taught bits, bytes and assembly language because higher-level languages were less prestigious.

For the teacher seeking to explore classroom applications of computing facilities, these courses were, and still are, a disaster. They left the course convinced that computing, as they had experienced it, was of no use in their classroom. And they were right! Most unfortunately, those aspects that were appropriate for

the classroom remained beyond their experience, and their now negative attitude was likely to keep it there.

Don't let a similar scenario adversely affect the positive potential of the microcomputer. College and other courses that use other than microcomputer hardware, that do not teach beginners BASIC or that do not provide hands-on experience are very likely doing more harm than good when the courses are billed as appropriate introductions for educators. The educational potential of the \$1000 microcomputer far exceeds that of other forms of computer support that is realistically available to today's elementary and secondary schools. If teachers are willing to take courses to improve their skills, they should not be given inappropriate material because that's the only thing available. Teachers should seek those courses that will provide the introduction they need, and must not settle for less.

On a much smaller scale, teachers should strive to make a student's first few computer experiences positive and rewarding. One very common way to do this is to allow students to begin by playing one or two popular games. This is only acceptable if the game is carefully chosen; it must be user-proof. The inexperienced user should be able to type absolutely anything without seeing an error message. The game must not be invincible. A first-time user should be more likely to win than lose. There is little reward in having a computer beat you in four out of four games, especially if they're the only four games you've ever played with the computer. The game must be exceptionally easy to understand, and the game should be fun.

One program that meets these qualifications asks the user to guess a secret integer between 1 and 100. Each incorrect guess is indicated as too high or too low. After the number is guessed correctly, the roles are reversed and the computer guesses a number made up by the user. Listing 1 contains a TRS-80 version of

```

100 CLS : PRINT @256, "I'M THINKING OF AN INTEGER BETWEEN 1 AND 100 INCLUSIVE"
110 PRINT : PRINT "TRY TO GUESS MY INTEGER"
120 CLEAR 200 : L=0 : H=101 : N=RND(100) : GOSUB 400
130 CLS : PRINT @256, "YOUR GUESS " : INPUT G : G=VAL(G)
140 IF G<0 OR G>INT(G) OR G>100 THEN PRINT "PLEASE USE INTEGERS BETWEEN
1 AND 100" : GOSUB 400 : GOTO 130
150 IF G<L THEN PRINT "YOU ALREADY KNOW MY NUMBER IS HIGHER THAN" L :
GOTO 200
160 IF G>H THEN PRINT "YOU ALREADY KNOW MY NUMBER IS LOWER THAN" H :
GOTO 200
170 IF G<N THEN PRINT "TOO LOW" : L=G
180 IF G>N THEN PRINT "TOO HIGH" : H=G
190 IF G=N THEN PRINT @256, CHR$(23)+"YOU GOT IT! GOOD WORK!"
200 GOSUB 400 : IF G<N THEN GOTO 130
210 CLS : PRINT @256, "NOW WE'LL REVERSE THE PROCESS"
220 PRINT @384, "YOU THINK OF AN INTEGER BETWEEN 1 AND 100 INCLUSIVE,"
230 PRINT "AND I'LL GUESS IT"
240 L=0 : H=101 : L1=1 : H1=100 : GOSUB 400 : GOSUB 400
250 G=INT((L+H)/2)
260 CLS : PRINT @256, "I GUESS" G : PRINT
270 INPUT "AM I (H)IGH, (L)OW, OR (R)IGHT?" : R$
280 R$=LEFT$(R$,1):IF R$<>"H" AND R$<>"L" AND R$<>"R" THEN GOTO 270
290 IF R$="H" THEN H1=H : H=G
300 IF R$="L" THEN L1=L : L=G
310 GOSUB 400 : IF G=L1 OR G=H1 THEN CLS : PRINT @256, "YOU'RE NOT GIVING
ME CONSISTENT ANSWERS" : PRINT "LET'S TRY THIS PART AGAIN" : GOSUB
400 : CLS : GOTO 220
320 IF R$<>"R" THEN 250
330 CLS : PRINT @256, CHR$(23)+"THAT WAS FUN -- I LOVE NUMBERS!" : GOSUB
400
340 CLS : PRINT @256, "HOPE YOU ENJOYED THIS EXERCISE" : PRINT
350 PRINT "I'LL BET YOU WRITE BETTER ONES PRETTY SOON"
360 GOSUB 400 : GOSUB 400 : END
400 FOR I=1 TO 1000 : NEXT I : RETURN

```

Listing 1. Number-guessing game for the TRS-80.

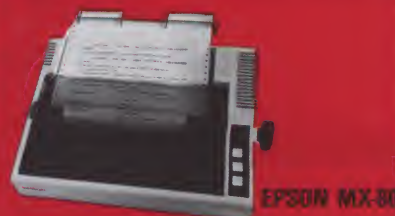
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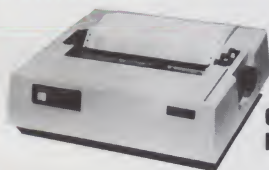


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this program. You'll have to type the program to see a sample run.

Notice that the program attempts to deal with all possible incorrect user responses by providing helpful messages. The user should never be faced with a BASIC error message or a prematurely terminated program. Note that line 130 uses a string variable when a numeric value is expected. This allows the user to enter anything without seeing the ?REDO message. Also notice that large letters are used as a change-of-pace reward. While this is a very simple example, programs should make the reward worth the effort. Finally, notice that the program doesn't allow the user to lose nor does it evaluate his performance. Although both of these elements are often desirable, neither is necessary in the student's first experience with the computer.

After the successful completion of a game or other interactive program, the first-time user can be introduced to programming. Although the first programs will not be elegant, they should be fun. The following sequence of first-encounter programs is suggested because they introduce new commands and elementary programming concepts in a way that is easy, fun and likely to lead to many other interesting questions.

Have the students enter and run the following initial program:

```
10 PRINT "JULIE"
20 GOTO 10
```

They should, of course, enter their own first names. This allows the introduction of line numbers, three commands (counting RUN), strings and the break key. Since almost everyone wants to see their name in lights, the program is fun.

The second program is a modification of the first. The string in line 10 should contain two spaces after the name and then be followed by a semicolon. This program appears as:

```
10 PRINT "JULIE ";
20 GOTO 10
```

Execution of this program always brings delight. And when done in an area with several microcomputers available, the effect is greatly enhanced. On the TRS-80, the program will fill the screen with JULIE and appear to be moving to the left. However, the name TOM will

move to the right, while the name WALTER will produce relatively dull columns that aren't moving at all.

Why do some names move left, some right, and some not at all? I've asked these questions of first-time users from third grade through adults who have answered correctly in each instance. Even third-grade students correctly answer the question. Although they haven't had formal instruction about division, they can correctly explain the results of this program by describing the division process and the remainder in their own words.

Another program for those learning to program is:

```
10 LET N=1
20 PRINT N
30 LET N=N+1
40 GOTO 20
```

This program is an effective vehicle for introducing the LET command. Ask students how to begin counting at 1000 rather than 1. Ask them how to count by 2's, by 5's, or how to count down.

Also, ask students to determine approximately how much time the computer will take to get to one million. After all, a device that measures time in microseconds should certainly be able to count from one to one million very rapidly.

The results of this assignment are almost always surprising (a TRS-80 requires about 8-1/2 hours to count from one to one million in this way), and the students' own activities as they develop procedures for obtaining their results are quite valuable. There are several related points that should be discussed. The most significant of these, in my opinion, is the largeness of large numbers. Very few children or adults have any intuitive feeling regarding large numbers. Most people watching this program being executed will guess that one million will be reached in two hours or less.

One million is a lot larger than we think. When the news reports that a new plane costs eight million dollars, someone is spending a lot of money. When the national debt exceeds one trillion dollars, we know that's a large number. But we have little feeling for how very large it really is. How long would it take our short program to count from one to one trillion?

Another topic often occurs when the more advanced student points out that he added the line 40 IF N<10000 THEN 20 to make it easier to time the program. That this command also consumes time during each loop should not be overlooked. How much time? I'll leave that as an exercise for the reader.

Secondary students might also calculate the time required for the following program to count from one to one million.

```
10 LET N=1
20 LET N=N+1
30 GOTO 20
```

Consider one more example. This one is for the many teachers and students whose first computer experience should not include numbers if enjoyment is an objective. The dependence upon sample programs that draw heavily on mathematical examples is not at all necessary. The TRS-80 program given in Listing 2 is a bare-bones version of a rather enjoyable game that we'll call Word Squeeze.

Word Squeeze begins by asking you to type a five-letter word that is alphabetically between "above" and "zebra." After you type your word, the program determines the shortest alphabetic "distance"—above to your word or your word to zebra. Suppose you typed the word "class." The alphabetic distance from above to class is shorter than that from class to zebra.

After the program determines which words define the shorter distance, the user must enter a word that is alphabetically between them. If, for example, you typed class, then you would next be asked to type a word that is alphabetically between above and class. If you responded with the word "break," you would next be asked to type a word that is alphabetically between break and class. And on and on.

In the Listing 2 program, the user does not win or lose Word Squeeze, he just plays. The program is offered as a starting point to which you can add many bells and whistles of your own. You might, for example, permit words of three or more letters rather than only using five-letter words. You might also check that each word entered contains at least one vowel and at least one consonant. Certainly, you can improve the scoring procedure, and you ought to provide a method for the user to quit more gracefully than pressing break.

Make every effort to make the first experiences of new users enjoyable ones. The ideas offered in this article hopefully demonstrate that these experiences can be not only enjoyable, but also challenging and stimulating. If you've some similar ideas that have worked for new users, send them in. Perhaps the best ones will be appropriate for a future column. □

```
100 L$="ABOVE" : H$="ZEBRA" : C=0
110 FOR X=1 TO 800 : NEXT X : CLS
120 PRINT @256, "TYPE A 5 LETTER WORD THAT IS ALPHABETICALLY" : PRINT
    "BETWEEN " L$ " AND " H$ " :
130 PRINT @768, C " ENTERED SO FAR" : PRINT @349, : INPUT N$
140 IF LEN(N$)<>5 OR L$>N$ OR H$<N$ THEN PRINT @448, "NO, TRY AGAIN"
    : GOTO 110
150 C=C+1 : IF C=15 THEN 200
160 FOR I=1 TO 5
170 N=ASC(MID$(N$,I,1))
180 A=N-ASC(MID$(L$,I,1))
190 B=ASC(MID$(H$,I,1))-N
200 IF A<B THEN H$=N$ : GOTO 110
210 IF B<A THEN L$=N$ : GOTO 110
220 NEXT I
```

Listing 2. Word Squeeze program.

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LETTERS TO THE EDITOR

Warning for Superboard II Users

If you own an Ohio Scientific Superboard II microcomputer and your power supply output is limited to 3 amps (such as a homebrew LM323K circuit), check the Superboard's fuse F1. I recently received my Superboard and hooked up an overvoltage protect crowbar circuit by clipping the crowbar's +5 V lead into the fuse clip (along with the fuse end) that is connected to the load side of the fuse (Superboard's +5 V bus). The crowbar was initially set to fire at too low a voltage, and fired one day when I was using the computer. However, fuse F1 did not blow, resulting in an extremely hot LM323.

The reason? As supplied, F1 was a 5 amp, 250 V fast blow fuse. The LM323's output current is limited to 3 amps, and so couldn't blow the 5 amp fuse. I was fortunate, as my crowbar circuit caused the short and I was right there to check it out. The real danger is a shorted IC on the Superboard, with no one around. The LM323 will just keep feeding 3 amps into the short until power is removed or something literally burns up, probably destroying the board.

I read in an article titled "Build a Home for Your Superboard" (April 1980 *Microcomputing*, from where I also got the crowbar circuit) that an 8K Superboard draws about 1.8 amps. Therefore, a 2 to 2.5 amp, fast blow fuse will hold, but definitely not larger than a 3 amp if you're using a 3 amp supply. I have a 4K Superboard and am using a 2 amp fast blow.

Ron Hassinger
RAF Chicksands, England

Paradoxical Processing

Your comments about word processing in the November issue ("Word Processor Woes," p. 7) touched one of my nerves, resulting in this letter. Several months ago my office took delivery of an NBI 3000 Word Processing System. This electronic phenomenon has produced more paradoxes than I possibly could have foreseen. For example:

The system produces documents of unbelievable quality, mostly due, however, to the excellent Diablo printer.

The turn-around time for a normal two-page proposal letter, from dictation to final document, has not decreased, but rather has almost doubled.

The freedom associated with the easy editing and correct capabilities has resulted in more relaxed and productive dictation and transcription sessions.

Although well-written, the operator's guide serves more as a reference manual, rather than as a training guide. Consequently, finding how to do something that isn't done very often is difficult and time consuming.

Every letter now goes through a "draft" stage, whereas many letters used to get typed only once, and then signed and mailed.

Many difficult typewriter functions have been simplified to a few keystrokes on the word processor. This, however, is offset by the fact that many easy typewriter functions, such as the "hanging indents," have become more complicated or time consuming.

The word processor doesn't replace a typewriter, but is still needed for many pre-printed forms or short notes.

The confounded machine picks the absolutely worst times to fail. It always happens at 3 PM as the almost-final draft of a twelve-page document (that must be mailed today) is being printed.

While the list could go on, I think it sufficiently expresses my frustrations. I am pleased with the professional quality that word processing lends to my correspondence and documents. I like the flexibility that word processing offers. I think the per-station costs are too high, but these will come down sharply over the next couple of years. I have a difficult time accepting the fact that while some tasks became easier, many other, more often used tasks became more cumbersome. But, no matter how well the letter is printed, regardless of the technology used to produce the document, in spite of the time and effort invested, the Post Office will still manage to lose it, mis-deliver it or destroy it!

Roland K. Smith
Datapoint Eastern Region
Sales Manager
Cleveland, OH

Megabytes on Cassette

A product has been on the market now for about a year that does just what you asked for in your November 1980 "Publisher's Remarks" (New Ideas, p. 8)—that is, allow the storage of 10 megabytes of Winchester data on a regular cassette.

The Corvus Mirror is a low-cost backup for the Corvus Winchester disk system employing standard video recording technology. It converts the output of the Corvus 10 or 20 megabyte Winchester disk into a stream of serial bytes which can be recorded on any videotape recorder. The most common video machine used for this purpose is the video cassette recorder because it offers the convenience

and low cost of easily available cassettes.

Data is backed up at a one megabyte per minute rate, permitting the entire contents of a Corvus Winchester disk to be copied in 10 to 20 minutes. Total capacity of a cassette is 120 megabytes. Thus, the Mirror serves not only as a security backup, but also provides archival storage. In a larger sense, it allows microcomputer users to enjoy both the sealed environment reliability of the Winchester disk system and the convenience of cassette loading at the same time by re-loading cassette data back onto the disk as needed.

Joseph D. Hughes
Vice-president, Marketing
Corvus Systems, Inc.
San Jose, CA

A Change in the Standings

Here's some new information that changes some of the data in your recent article "The 16-Bit Time Trials" (*Kilobaud Microcomputing*, October 1980, p. 182).

The Z8000 CPUs are now available from both Zilog and Advanced Micro Devices in 6 MHz clock rate versions (called the 8001A and 8002A). Use of the A version reduces cycle times to two-thirds that of the 4 MHz parts, resulting in execution times and rankings in your Table 2 of 32 us (#1) for table lookup, 712 us (#3) for block move, 5.3 us (#1, tie) for jump table and 13.3 us (#3) for multiply. The execution time index changes to 0.596 (#2), and the overall index changes to 0.799, which makes the Z8000 number one in rank.

John Springer
Advanced Micro Devices, Inc.
Sunnyvale, CA

All Shapes and Sizes

Arnold Bragg's article "Area Estimation" (October 1980, p. 112) showed an amazingly effective algorithm for its simplicity. Its greatest weakness is that only straight lines (not curves) are fitted between the data points.

To test the formula for its ability to fit curves, I used a circle with the radius of 1 and chose the data points so they were equally spaced around the circumference. For comparison, I also calculated the area of an N-sided inscribed polygon. The area determined by the formula is always the area of the inscribed polygon.

Fitting a curved line is more of an inconvenience rather than a fault of the al-

gorithm. Any inconvenience the fitting creates is more than made up for by the algorithm's ability to fit very complex shapes. The only time the algorithm failed was for the ring figure, and I tried to do the outside and the inside area in one pass. This could easily be handled by making two passes—one for the outside and the second one for the inside—and then subtracting the differences.

Bob Fruit
Hinsdale, IL

A Sound Idea

It seems to me that it would be fairly easy to rig up one of the popular microcomputers to print stenotype which puts the sounds of words on paper, from voice. You would need something to recognize phonemes (the Radio Shack Vox Box might do) and a special character generator of stenotype symbols for the video display and/or printer. The software would amount to a lookup table to make the proper conversion.

Three of the four major television networks are now captioning some of their programs for the deaf. But captioning costs about \$2500 per hour. If the deaf can learn to read stenotype, then the captions could be produced automatically.

A deaf person with his own steno-converter wouldn't need broadcast captions.

He wouldn't even be limited to television; he could "hear" the radio, the telephone and people in the room too. When all this is boiled down into a handheld unit—the size of the TRS-80 Pocket Computer, say—he could use it wherever he is, eliminating much of his disability.

The hardware for a home system is already available, or nearly so. The software should be easy. There should be a reasonable market for it (don't forget secretaries typing from recordings). Any takers?

Everett Ogden
Delmar, NY

Inflation

I've followed you for the last 25 years through many troubled times, and I always enjoy your editorials. That is, till October 1980 in *Kilobaud Microcomputing* ("The Detroit Syndrome," p. 6).

I am a tool and die maker and a UAW (United Auto Worker) member. I subscribe to three of your magazines—73, *Kilobaud Microcomputing* and *80 Microcomputing*. I make my living as an overpaid auto worker, and I buy an overpriced magazine. I work hard and with good productivity. My company (J. I. Case) makes a good profit.

Robert L. Kennedy K9DXB
Merom, IN

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If you have an Apple, Pet or TRS-80 microcomputer,* you can have fantasy at your fingertips with Epyx computer games from Automated Simulations.

Like me, you're probably really into games, all sorts of games. But an Epyx game is more than a game — it's an experience, and it's a chance to use your computer for something other than work. The great thing about Epyx games is that you have a choice. Whether you're a beginner or an expert, you can find games that are easy to learn. Challenging. Fun to play for twenty minutes or

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stolen treasure and save
money. So
can you!"**

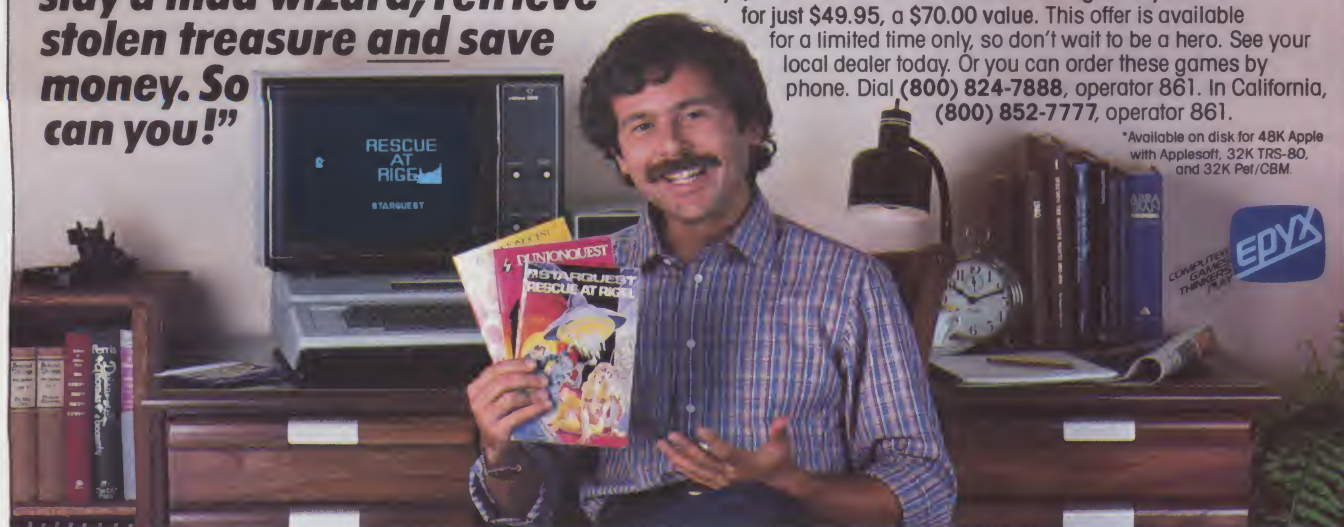
hours at a time. You can play these games over and over, because you're constantly trying new tactics and strategies.

I've already entered and re-entered a world of monsters and misfits, demons and dwarves, trials, tribulations and treasures with a game called "Temple of Apshai." Now it's my chance to have fun with three more games from Automated Simulations... and I can save money, too!

With "Datestones of Ryn" and "Morloc's Tower," I get to escape from booby-trapped mazes, find more treasures and zap more monsters. And with "Rescue at Rigel," I get to outwit the nasty High Tollah and free 10 prisoners.

Automated Simulations has a special offer on "Datestones of Ryn," "Morloc's Tower" and "Rescue at Rigel." Buy all three for just \$49.95, a \$70.00 value. This offer is available for a limited time only, so don't wait to be a hero. See your local dealer today. Or you can order these games by phone. Dial (800) 824-7888, operator 861. In California, (800) 852-7777, operator 861.

*Available on disk for 48K Apple with Applesoft, 32K TRS-80, and 32K Pet/CBM.



Bill Blue Moves On

The founder of ABBS starts a message system for Apple owners

In this article, we will visit with one of the major contributors to the microcomputer side of the data communications industry, Bill Blue. We will also look at the Lynx, one new modem system for the TRS-80 and Apple.

Mr. ABBS?

Bill Blue has been referred to in this column and in other places as the father of the Apple Bulletin Board electronic message and program transfer system. There are, by far, more ABBSes operating than any other type of system. But surprisingly, Bill opened this interview by asking to be dropped from the ABBS family tree.

Blue: "It's true that I was heavily involved in the original development of the ABBS software, but I haven't had anything to do with it for over a year. The very first software in skeleton form was written by Craig Vaughn (now with Source Telecomputing Corporation). I took this basic structure and added my own ideas and features. The software was distributed through Peripherals Unlimited, which was Craig's company at the time. He and I worked together on version 3.0, but I haven't had anything to do with the ABBS software since about June 1979."

Microcomputing: "Then what are you doing now?"

Blue: "I have several projects going. All still relate to the Apple computer. My long-term labor of love is the People's Message System. The PMS is totally my concept of what is capable of being done on an Apple system, and I am very proud of the way it has turned out. I originally wrote it just for myself, but recently decided to make it available for others. There are now six PMSes on line and more on the way. Those on line in California include my own in Santee, plus San Diego, Anaheim, Los Angeles and Palo Alto. There is also one on the Gulf Coast at Freeport, TX."

Microcomputing: "What are some of the features of the PMS that make it special? What is the philosophy guiding the features you put in?"

Blue: "I've tried to make the PMS much more than just a message system. I try to be innovative and provide ideas that are new to the field, but still keep the system bullet-proof and easy to operate. This gets tough because the more features you put in the more complex the software becomes.

"For example, I got very tired of having to scan messages and then type in all the message numbers that I wanted to read, so I came up with flagging. The People's Message System was the first to incorporate that feature. All you have to do is type the letter R when you see a message you would like to read later. After you have marked all the messages you want to read, you type an asterisk and they come back in chronological order.

"To get away from the message-only kind of system, I added program downloading—also the first of its kind in the country."

Microcomputing: "Downloading is the ability to transfer programs from the message system to a calling user's Apple?"

Blue: "Yes. And then came program uploading—from the users to the system. I thought it would be a terrific way to exchange programs. Unfortunately, I quickly learned that people were very eager to spend much time in taking programs from the system, but they were very slow to contribute anything. That situation has improved recently, and all the programs I offer on the download section have been contributed by users of the system.

"Lately, on my system in Santee, I

have been concentrating more on the "features" section. These range from articles of general interest to editorials contributed by users. The Anaheim PMS is concentrating on the video field, and the Palo Alto PMS is centering around Apple-related articles."

Microcomputing: "That's quite a project. It sounds like you are becoming an electronic publisher. What else has been keeping you busy?"

Blue: "My second big project is the ASCII Express. The Express is a communications program for the Apple that turns it into a smart terminal for data communications operations."

Microcomputing: "We reviewed the program in the July 1980 issue."

Blue: "Yes, and I am still getting orders from that initial review! But now I have a much-updated version I call ASCII Express II. It fully supports upper and lowercase and allows conversational copy as well as a formal file transmission capability. I have included a line editor that can be used to make up messages off line and it has fully programmable keyboard MACROS for very fast semiautomatic log in and command execution."

Microcomputing: "What does it sell for and what kind of equipment do you need to use it?"

Blue: "I thought you'd never ask! It sells for \$59.95 and is marketed by Southwestern Data Systems. It is a disk-based program, so you have to have an Apple II with at least one disk drive. You need either Applesoft in ROM or the language card. It works well with the D. C. Hayes modem board, but it can also be

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Los Angeles, CA	213-291-9314	(Evenings and weekends only)
Palo Alto, CA	415-492-7691	
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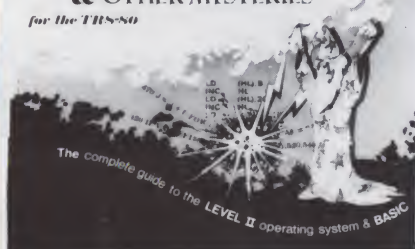
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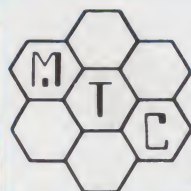
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The Lynx modem by EMTRON Systems provides full-originate and answer capability for the TRS-80 model I.

used with a communications card and standard modem."

Microcomputing: "But that's a finished product. What's next?"

Blue: "Well, the ASCII Express and the People's Message System will never be stagnant. I'm going to keep improving both of them. But for the future, I will soon have a similar terminal package available for the CP/M Apple with the Z-80 softcard. It is called Z-Term and will also be available through Southwestern Data Systems. In addition, I am working on another program I call Online. This is a private message system for those who want to limit access to only authorized users. It will have message upload and download, user account codes, private mail and editing functions."

Microcomputing: "Any words on the outlook for the future of data communications systems?"

Blue: "I'm sure it is obvious to most who have been following your articles or have been participating in this area that

we are still just at the starting point of what could be one of the most significant changes in communications since radio and television. This form of communications has been around for years, but only among those "elite few" who were in some way involved with a large company or government computer network. The microcomputer has made this communications form open to everyone. As more persons become computer-literate it will be possible for country-wide communications via computer to be an everyday occurrence in a typical household. I think it's just great and I am thrilled to be a part of it."

(Bill's software products are available from Southwestern Data Systems, PO Box 582, Santee, CA 92071.

The Lynx

I first mentioned the Lynx in the December 1980 Dial-Up Directory (p. 202). The Lynx is a modem for the TRS-80 Level I which does not need the expansion interface to operate. I have used the equipment now for several months and I am impressed with it. At a trade show in December, a Lynx for the Apple II was demonstrated. I don't have any further details right now, but the following description of the TRS-80 Lynx should apply pretty well to the Apple version.

The Lynx plugs directly into the TRS-80 keyboard or the expansion interface. The installation takes about 30 seconds and is well-illustrated in the instruction manual. The Lynx fits nicely under a desk-style telephone and is color-coordinated with the TRS-80.

The modem is well-built, on one high-quality circuit board. The power supply is a typical line cord transformer. Originate and answer modes of operations and the default values of the word length and parity are selected by switches on the back panel. The large Data-Talk switch on the front panel is easy to use, but I would like to see some warning indicator, perhaps an LED or a physical color change, when it is in the data position. Several times family members have tried to use the phone hooked to the Lynx and

found it dead because I hadn't flipped back to talk.

The Lynx is a complete system. It comes with its own terminal emulation (EMTERM) software on cassette for either the TRS-80 Level I or II. Even a very bare-bones Level I system can prepare messages off line, store them for future transmission, and act as a terminal with the ability to send control codes and escape. The Lynx EMTERM program also allows changes to be made to the parity, word length and number of stop bits from the keyboard.

The Store Message command establishes a 1024-character buffer in RAM for writing a message. There is no line editing. Once you get on line with the system or TRS-80 you are exchanging data with, the shift right arrow command will send the message contained in the buffer out the Lynx port. The message buffer is not erased, so the message can be transmitted again to other systems.

The Terminal mode is the normal mode of operation. This dumb terminal emulator provides all the capability you need for operation with all electronic message systems and information utilities. It isn't fancy, but it works! If you have a printer with a parallel interface, it can print received data as it comes in. This is the next best thing to having a disk-based smart terminal saving the data in files. The terminal software includes a command for toggling the printer on and off.

The TRS-80 Level II program adds two more features, which let you transmit and receive BASIC programs. The transmission feature will allow loading a program into RAM from cassette. The program can be transmitted as soon as the receiving station is ready. If you receive a program using the BASIC Receive option, you can then run, list or CSAVE it.

Documentation for the Lynx is like the software—simple but adequate. The eight-page manual tells you what you need to know to operate the system, but not much more. No schematic diagrams or program listings are provided.

The Lynx hardware will also operate with any other software package designed for the standard TRS-80 communications configuration. The Lynx will not work on a TRS-80 that has the standard RS-232 board in place. The inclusion of the practical EMTERM program in the \$235 Lynx package makes it a good value. You can easily put a Lynx/TRS-80 Level I terminal on line for under \$700. It would be difficult for any commercial supplier to match its performance at that price.

If you have any data communications comments or questions, send them to me at PO Box 691, Herndon, VA 22070. Include a stamped envelope if you want a reply. Electronic mail is welcome at TCB967 on The Source, 70003.455 on CompuServe or the AMRAD CBBS (703-734-1387). □

MICRO QUIZ

What Does This Program Do?

When statement 110 is reached, what is the value of V?

```

10 DIM X(20)
20 DATA 6,4,9,2,5,1,8
30 READ N
40 FOR I = 1 TO N
50 READ X(I)
60 NEXT I
70 V = X(1)
80 FOR J = 2 TO N
90 IF X(J) > V THEN V = X(J)
100 NEXT J
110 PRINT V
120 END

```

(answer on page 150)

4 ALL NEW GUIDES

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The Apple II User's Guide by Lon Poole, Martin McNiff, and Steven Cook #46-2, \$15. □

This Guide is the key to unlocking the full power of your Apple II or Apple II plus computer. The Apple II User's Guide brings together in one place a wealth of information for Apple computer users. It will tell you more about your Apple than any other single source. This book will save you both time and effort. No longer will you have to search endlessly for useful information. It's all here, in the Apple II User's Guide, thoughtfully organized and easy to use. Topics include:

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*Advanced programming - special sections describe High Resolution graphics techniques and other advanced applications.

*Hardware features - the disk drive and printer are covered in separate chapters.

*Machine level programming - although not a machine language programming guide, this book covers the Machine Language Monitor in detail.

*Apple is a trademark of the Apple Computer Corporation.

PET/CBM Personal Computer Guide Second Edition by Adam Osborne and Carroll Donahue #55-1, \$15. □

The PET/CBM Personal Computer Guide is a step-by-step guide that assumes no prior knowledge of computers. If you can read English, you can use this book. This revised second edition provides even more useful material than the popular first edition. It covers the most recent CBM products: the CBM 8000 and 4000 series computers, the 2040 and 8050 disk drives, and programmable printers. Adam Osborne co-authored this new edition. He has re-written it to be a step-by-step BASIC tutorial. So if you don't know BASIC, don't worry. This book will teach you both BASIC and CBM BASIC. If you're thinking about buying any personal computer, this book will show you what the PET can do for you. If you've just bought a PET or CBM, this is the book you must have to really understand your computer. By using the examples found in this book you'll quickly get your PET/CBM up and running. These examples are thoroughly documented so you can learn how and why the programs work. It's the "how" and "why" that are important in learning to make the PET work efficiently for you. The PET Personal Computer Guide covers everything you'll need to be master of your PET.

*PET and CBM are both trademarks of Commodore Business Machines.

CP/M User's Guide by Thom Hogan #44-6 \$12.99 □

If you haven't yet purchased CP/M for your system, the CP/M User's Guide will make your first use of CP/M easy. If you already have CP/M, this book will help you modify your system and let you "jockey your disks" like an expert. The CP/M User's Guide describes all types of CP/M and their compatibility. It includes a discussion of conventions used to create file names and command lines. Numerous sample screen displays for every version of CP/M graphically explain every operator command and computer response. CP/M's Assembly Language Utilities are described for the non-technical reader who wants maximum use of CP/M's capabilities. The book also discusses how application packages, high level languages, solution programs, and other support programs combine with CP/M to answer a user's individual needs. You'll also find an explanation of MP/M and CP/NET as well as the technical aspects of CP/M's internal structure which will permit you to make simple modifications. A full glossary and several useful appendices are included.

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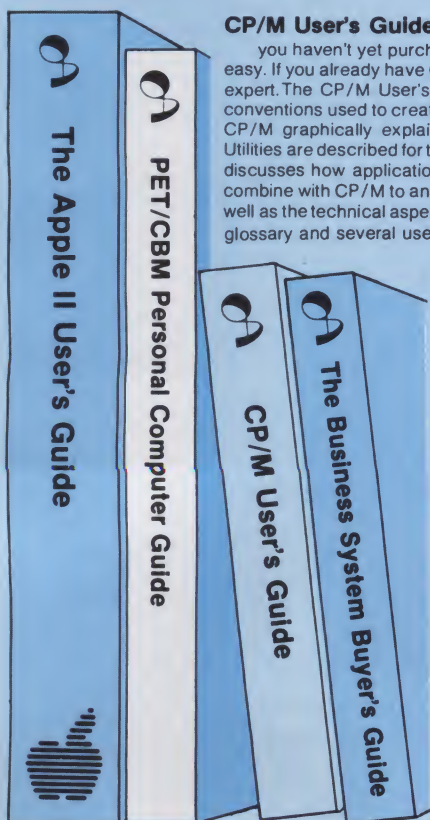
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Humanitarian Computerists

Over 800 micro users form a network to help refugees

Micros Reuniting Families

An international microcomputer network is helping to reunite Vietnamese families that were separated after emigrating from Indochina.

Family Reunification Services, based in Calgary, Alberta, Canada, includes some 800 microcomputerists in 23 countries. The service, in operation since August 1980, has brought together members of almost 200 families.

The way the service works, each micro user gathers from local humanitarian groups the names of Vietnamese who have resettled in his area and are looking for relatives. He sends the list on tape to the next computerist, who checks it against his list. He adds the names from his area, and mails the cassette to the next station.

If a computerist finds a match, he sends the information to Calgary, and the two parties are notified.

Locating the family members is only the first step. Getting them together is another matter, says FRS President J. E. Caruana, and can be a complicated process.

"Here we get into dollars and cents," Caruana says. "Where do they get the money to travel?"

"Also, a person who has resettled is no longer a refugee, and we get into legal and immigration problems. If one family member has to move to another country, does that country have quotas? And what constitutes a family? Is a son through marriage a family member?"

Families sometimes have to relocate over great distances or from one country to another. One family, Caruana says, had to move from Houston, TX, to Montreal, Canada.

Caruana became involved in the refugee movement in 1978. He has since quit his job, and with the financial backing of some local businessmen, runs the FRS full-time. "I work 56 hours a day, 18 days a week, 38 months a year," he says.

The project, he says, will probably go

on for another couple of years. "Maybe then we can call the whole thing to a halt and say, 'Hey, we've really accomplished something,'" he says.

What will happen to the network? Caruana, the owner of a TRS-80, hopes to maintain it as a sort of users group that will swap information and ideas on microcomputing in general.

Caruana says that several governments have expressed an interest in the concept of FRS.

"Suppose there were another earthquake in Italy, or an upheaval in Chile," he says. "Something like this could become very useful." But at the moment, Caruana is only interested in reuniting Vietnamese families. "I believe in the cause," he says.

Any microcomputerist, regardless of what kind of system he has, is invited to join the network. For more information, write the FRS, 7203 Huntercrest Road N.W., Calgary, Alberta, Canada T2K 4J9.

Source Offers Job Listings

The Source and Computer Search International are now offering a listing of job opportunities and resumes through The Source's information network.

The CSI "Career Network" is supported by a membership of executive recruit-

ing firms in major cities in the United States, England and Australia. Descriptions of corporate job opportunities and individual resumes are listed. Individuals and corporations can sort through the job market data with reference to salary range, geographic location, job experience, education and special skills. The service includes 40 job categories, displaying the several that apply to any applicant or corporation.

All information listed on the Career Network is confidential. Resumes and job openings are key-coded to the CSI Career Network member recruiting firm that holds the listing. Follow-ups are made directly to the member firm or directly to Computer Search International, in Baltimore.

Peripheral Sales to Soar?

Sales of mini and microcomputer peripherals will increase by 400 percent over the next ten years, claims a recent report from International Resource Development, Inc.

In addition, the IRD report forecasts that:

● Floppy disk drives, Winchester drives and other mass storage devices will remain the single largest segment of the market.

Peripheral Category	1980	1982	1985	1990
Data Entry Equipment	240	370	915	1,730
Printers	560	780	1,010	1,185
Memory	300	750	1,150	1,650
Disk/Tape	1,000	1,850	2,565	2,670
G P Terminals	650	1,100	1,650	3,450
Datacomm Equipment	370	665	925	1,915
Sub-total	3,120	5,515	8,215	12,600
Integral Peripherals	240	260	2,115	17,400
Totals	3,360	5,775	10,330	30,000

Mini/micro peripheral shipments for 1980-1990. (Source: International Resource Development, Inc.)

- Total printer shipments for mini/micro systems will jump from \$500 million in 1980 to \$1 billion in 1990. Half of those printers will be nonimpact.

- More and more microcomputer products will have built-in telecommunications abilities and will be used to access a variety of new information services and data bases.

- While there is now about one terminal for each 20 white collar desks, the proportion will be one in three by the end of the decade.

- More than half of the 100+ firms now making mini/micro peripherals will disappear.

- Xerox, which owns Shugart and Diablo, could become the leading supplier of mini/micro peripherals in the 80s.

For more information on the report, contact IRD at 30 High St., Norwalk, CT 06851 (Tel. 203-866-6914, Telex 64 3452).

School Pushes Telecom

Golden Gate University in San Francisco is going into telecommunications in a big way. The school has established two new undergraduate programs in telecommunications management and has appointed four telecommunications professionals to the faculty.

Students will be offered a B.S. in telecommunications management, as well as graduate and undergraduate certification in telecommunications management if they don't want the degree.

Courses include Introduction to Telecommunications Management, Corporate Telecommunications, Survey of Data Communications Systems, Networks and Switching Systems, Legal and Regulatory Aspects of Telecommunications, Telecommunications Technology and Society, Teleconferencing and Satellite Systems, and Viewdata and On-line Commercial Information Systems.

For information, write GGU, 536 Mission St., San Francisco, CA 94105.

TV Station Uses Computer for Elections

WOWK-TV in Huntington, WV, used a small business computer to tabulate election returns during the Presidential elections in November.

Returns were phoned in to WOWK by League of Women volunteers from precincts in the West Virginia-Ohio-Kentucky triangle. Station personnel then keyed the figures into a Pertec PCC 2000 system. Four terminals computed the returns, while a fifth broadcast the results to home viewers.

The old method is to tabulate returns manually. Incoming results are flashed in handwritten numbers, which are then entered into the video equipment. The

PCC 2000 provided more accuracy, and also let viewers watch the results change on the terminal.

Vroom Vroom

The computerized motorcycle has arrived.

The Yamaha SECA 750 uses a microcomputer to monitor the sidestand, the brake fluid level, the battery fluid level, the fuel level, the engine oil level, the headlight, the taillight and the stoplight.

The system consists of the micro, an integrated circuit board, a liquid crystal diode and sensors for the key functional areas being monitored.

When the driver turns on the ignition, the handlebar-mounted computer first reports its condition before beginning to analyze the sensed areas two seconds later. When the monitored function is in working order, there is a brief burst of light on the LCD confirming this. But, if a problem—however minor—arises in any of the functions subject to the computer's scrutiny, the LCD remains lit.

Suggested retail price is expected to be less than \$3500.

Videotex '81

Videotex '81, the first major conference and exhibition on videotext in North America, is set for May 20-22 in Toronto, Ontario.

The conference program will run in three parallel streams. The first will cov-

er current videotext developments around the world, and will include reports from the UK, France, Germany, Japan, Canada and the US. The other two will be for executives looking for new and more effective corporate information systems and for businessmen looking for opportunities as entrepreneurs, information providers and equipment suppliers.

Conference topics will include advertising through videotext, teleshopping and direct marketing, electronic mail, electronic funds transfer, education, entertainment, database publishing, impact on newspapers, private videotext systems, syndicated user groups, interactive cable TV, teletext, intelligent terminals and personal computers, regulatory and legal issues, market development projections and the social impact of new technology.

For more information, contact Pam Carter, Videotex '81, Infomart, 122 St. Patrick St., Toronto, Ontario M5T 2X8, Canada (Tel. 416-598-1981, Telex 0622111).

Quote of the Month

"We might stop having printed magazines, and everything might appear on a screen someplace, but I don't think that that's any less a magazine. If people prefer to read it sitting in front of a screen, fine, we'll create such an editorial product."

—Edward Thompson, Editor in Chief of *Reader's Digest*, which recently bought *The Source* information network; quoted in *Next* magazine.

The Yamaha SECA 750, the world's first computerized motorcycle. The computer console is shown in the inset.



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AS THE WORD TURNS

By Eric Maloney

Etymological Gymnastics

Several years ago, the newspapers covered a number of dramatic stories about parents hiring kidnappers to rescue their children from unorthodox religious groups. These kidnappers would take the children into a motel room for several days and nights in an attempt to "deprogram" them.

Nobody gave the word "deprogram" much thought at the time. But it is a prime example of how the computer world can borrow a word, change the meaning and reintroduce it into everyday language.

The original meaning of the verb "program" is, according to the *Oxford English Dictionary*, "To arrange by or according to a program; to draw up a program of; to scheme or plan definitely." They illustrate with an example from the sports world: "This match was programmed to start yesterday."

When computerists took the word for their own use, they modified and narrowed its definition. "Program" came to mean the act of preparing a set of instructions telling a computer what to do. A program, says Charles J. Sippl's *Microcomputer Dictionary and Guide*, includes "plans for the transcription of data, coding for the computer and plans for the absorption of the results into the program."

Eventually, computers caught the attention of the general public, and people became familiar with the concept of programming. It was only a matter of time before the idea was applied to humans, as a synonym for indoctrination or brainwashing.

(It is interesting that programming, in itself a neutral act, has come to indicate a cold, inhuman, ultimately destructive process. This says something about how people perceive computers. I'll deal with this in a later column.)

Several other computer words are working their way into the common language. "Interface" is an example.

The *OED*, published in 1935, defines an interface as "a surface lying between

two portions of matter or space." Scientists extended that meaning to include, according to the 1976 *OED* supplement, "An apparatus designed to connect two scientific instruments, devices, etc., so that they can be operated jointly."

Finally, the social scientists applied it to the field of human experience, using the word to indicate "A means or place of interaction between two systems, organizations, etc.; a meeting-point or common ground between two parties, systems or disciplines; also, interaction, liaison, dialogue."

"Interface" has since become a buzzword meaning "to talk." It is interchangeable with "rap," "relate" or "interact." For example: "Why don't we go to lunch, and interface?"

"Peripheral" is another one. Originally an adjective, it means "Of, pertaining to, or situated in, the periphery . . . of the surface or outward part of an organic body, especially in peripheral neuritis, inflammation of one or more nerves of both sides." Computerists made it a noun, meaning any device that works with a computer but is not a part of it.

This word isn't used as much as "program" or "interface," but it's only a matter of time. I predict that within ten years, we'll be buying peripherals for our blenders, outdoor barbecue sets, trash compactors, and probably even our wristwatches.

What's next? "Modem" has a good chance of making it into our everyday language, as soon as enough businessmen start using them. Other possibilities include "debug," "buffer" and "software."

Then there are all the possible new idiomatic expressions. Someone not in the mainstream of office activities is "out of the loop." A person no longer in complete control of his senses is characterized as having "blown a disk."

If you've heard any interesting new expressions using computer terminology, drop me a line. I'll put them in my buffer for a future column. □

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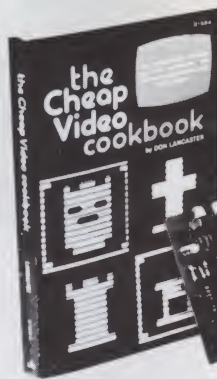
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Air Flight Simulation—Your mission: Take off and land your aircraft without crashing. You're flying blind—on instruments only.

A full tank of fuel gives you a maximum range of about 50 miles. The computer will constantly display updates of your air speed, compass heading and altitude. Your most important instrument is the Angle of Ascent/Bank Indicator. It tells if the plane is climbing or descending, whether banking into a right or left turn.

After you've acquired a few hours of flying time, you can try flying a course against a map or doing aerobatic maneuvers. Get a little more flight time under your belt, the sky's the limit.

Colormaster—Test your powers of deduction as you try to guess the secret color code in this Mastermind-type game. There are two levels of difficulty, and three options of play to vary your games. Not only can you guess the computer's color code, but it will guess yours! It can also serve as referee in a game between two human opponents. Can you make and break the color code...?

Star Ship Attack—Your mission is to protect our orbiting food station satellites from destruction by an enemy star ship. You must capture, destroy or drive off the attacking ship. If you fail, our planet is doomed...

Trilogy—This contest has its origins in the simple game of tic-tac-toe. The object of the game is to place three of your colors, in a row, into the delta-like, multi-level display. The rows may be horizontal, vertical, diagonal and wrapped around, through the "third dimension". Your Apple will be trying to do the same. You can even have your Apple play against itself!

Minimum system requirements are an Apple II or Apple II Plus computer with 32K of memory and one minidisk drive. Mimic requires Applesoft in ROM, all others run in RAM or ROM Applesoft.

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Paddle Fun

This new Apple disk package requires a steady eye and a quick hand at the game paddles! It includes:

Invaders—You must destroy an invading fleet of 55 flying saucers while dodging the carpet of bombs they drop. Your bomb shelters will help you—for a while. Our version of a well known arcade game! Requires Applesoft in ROM.

Howitzer—This is a one or two person game in which you must fire upon another howitzer position. This program is written in HIGH-RESOLUTION graphics using different terrain and wind conditions each round to make this a demanding game. The difficulty level can be altered to suit the ability of the players. Requires Applesoft in ROM.

Space Wars—This program has three parts: (1) Two flying saucers meet in laser combat—for two players, (2) two saucers compete to see which can shoot out the most stars—for two players, and (3) one saucer shoots the stars in order to get a higher rank—for one player only. Requires Applesoft.

Golf—Whether you win or lose, you're bound to have fun on our 18 hole Apple golf course. Choose your club and your direction and hope to avoid the sandtraps. Losing too many strokes in the water hazards? You can always increase your handicap. Get off the tee and onto the green with Apple Golf. Requires Applesoft.

The minimum system requirement for this package is an Apple II or Apple II Plus computer with 32K of memory and one minidisk drive.

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With the price of fossil fuels rising astronomically, solar space-heating systems are starting to become very attractive. But is solar heat cost-effective for you? This program can answer that question.

Just input this data for your home: location, size, interior details and amount of window space. It will then calculate your current heat loss and the amount of gain from any south facing windows. Then, enter the data for the contemplated solar heating installation. The program will compute the NET heating gain, the cost of conventional fuels vs. solar heat, and the calculated payback period—showing if the investment will save you money.

Solar Energy for the Home: It's a natural for architects, designers, contractors, homeowners... anyone who wants to tap the limitless energy of our sun.

Minimum system requirements are an Apple II or Apple II Plus with one disk drive and 28K of RAM. Includes AppleDOS 3.2.

Order No. 0235AD (disk-based version) \$34.95

Math Fun

The Math Fun package uses the techniques of immediate feedback and positive reinforcement so that students can improve their math skills while playing these games:

Hanging—A little man is walking up the steps to the hangman's noose. But YOU can save him by answering the decimal math problems posed by the computer. Correct answers will move the man down the steps and cheat the hangman.

Spellbinder—You are a magician battling a computerized wizard. In order to cast death clouds, fireballs and other magic spells on him, you must correctly answer problems involving fractions.

Whole Space—Pilot your space craft to attack the enemy planet. Each time you give a correct answer to the whole number problems, you can move your ship or fire. But for every wrong answer, the enemy gets a chance to fire at you.

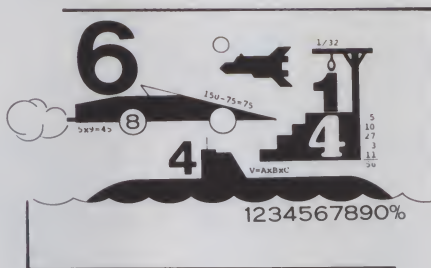
Car Jump—Make your stunt car jump the ramps. Each correct answer will increase the number of buses your car must jump over. These problems involve calculating the areas of different geometric figures.

Robot Duel—Fire your laser at the computer's robot. If you give the correct answer to problems on calculating volumes, your robot can shoot at his opponent. If you give the wrong answer, your shield power will be depleted and the computer's robot can shoot at yours.

Sub Attack—Practice using percentages as you maneuver your sub into the harbor. A correct answer lets you move your sub and fire at the enemy fleet.

All of these programs run in Applesoft BASIC, except Whole Space, which requires Integer BASIC.

Order No. 0160AD \$19.95



Skybombers

Two nations, separated by The Big Green Mountain, are in mortal combat! Because of the terrain, their's is an aerial war—a war of SKYBOMBERS!

In this two-player game, you and your opponent command opposing fleets of fighter-bombers armed with bombs and missiles. Your orders? Fly over the mountain and bomb the enemy blockhouse into dust!

Flying a bombing mission over that innocent looking mountain is no milk run. The opposition's aircraft can fire missiles at you or you may even be destroyed by the bombs as they drop. Desperate pilots may even ram your plane or plunge into your blockhouse, suicidally.

Flight personnel are sometimes forced to parachute from badly damaged aircraft. As they float helplessly to earth, they become targets for enemy missiles.

The greater the damage you deal to your enemy, the higher your score, which is constantly updated at the bottom of the display screen.

The sounds of battle, from exploding bombs to the pathetic screams from wounded parachutists, remind each micro-commander of his bounden duty. Press On, SKYBOMBERS—Press On!

Minimum system requirements: An Apple II or Apple II Plus, with 32K RAM, one disk drive and game paddles.

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Santa Paravia and Fiumaccio

Buon giorno, signore!

Welcome to the province of Santa Paravia. As your steward, I hope you will enjoy your reign here. I feel sure that you will find it, shall we say, profitable.

Perhaps I should acquaint you with our little domain. It is not a wealthy area, signore, but riches and glory are possible for one who is aware of political realities. These realities include your serfs. They constantly request more food from your grain reserves, grain that could be sold instead for gold florins. And should your justice become a trifle harsh, they will flee to other lands.

Yet another concern is the weather. If it is good, so is the harvest. But the rats may eat much of our surplus and we have had years of drought when famine threatened our population.

Certainly, the administration of a growing city-state will require tax revenues. And where better to gather such funds than the local marketplaces and mills? You may find it necessary to increase custom duties or tax the incomes of the merchants and nobles. Whatever you do, there will be far-reaching consequences...and, perhaps, an elevation of your noble title.

Your standing will surely be enhanced by building a new palace or a magnificent *cattedrale*. You will do well to increase your landholdings, if you also equip a few units of soldiers. There is, alas, no small need for soldiery here, for the unscrupulous Baron Peppone may invade you at any time.

To measure your progress, the official cartographer will draw you a *mappa*. From



it, you can see how much land you hold, how much of it is under the plow and how adequate your defenses are. We are unique in that here, the map IS the territory.

I trust that I have been of help, signore. I look forward to the day when I may address you as His Royal Highness, King of Santa Paravia. *Buona fortuna* or, as you say, "Good luck". For the Apple 48K.

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Building the H-89

By Martin Moore

Perhaps you're in the situation where you want a computer, you need a terminal and you need mass storage. But you don't want to pay three separate prices for three separate boxes—that may or may not work together.

Well, that was my predicament. I wanted a system for text processing. I wanted a fairly fast computer, a high-quality terminal with a decent type-writer-style keyboard and a floppy disk. Most of all, I wanted it in one box that wouldn't take up all my desk space. And I wanted it for under \$1500.

I had about given up when in late May of 1979 our friendly postman delivered into my hands a copy of the Heath catalog. And right in the middle was just what I wanted. Heath billed it as the H-89 "all-in-one" computer—a Z-80 controlled terminal, a Z-80-based computer and a 5-1/4 inch floppy drive. All in a small package. Terrific! I ordered one in mid-June of that year. It all came together in mid-October.

Building the Heathkit H-89

What arrived on my doorstep weighed 86 pounds and was distributed among three boxes. The first thing I noticed was that one of the boxes had arrived with its sides bashed in. With some trepidation, I gingerly opened the package to find a 12-inch CRT. Incredibly, the box had been crushed in around the neck of the tube, leaving the glass unscathed.

The smallest box contained a Wangco Model 82 flexible disk drive. The largest box contained the H-89 it-

self. Inside the large box were two smaller boxes and the computer chassis. One of the smaller boxes, the "open me first" box, contained the assembly and operating manuals. The first rule of kit building is to read the assembly manual all the way through—before you begin to build the kit. This little step saves you a lot of headaches. If you want it to work the first time, read the book.

The assembly manual was laid out in Heath's usual excellent fashion. After adding the errata sheets (no one's perfect), I went to work.

Each step of construction is clearly explained, giving detailed information about each phase of assembly. If you've had to contend with other manufacturers' assembly instructions, you'll appreciate Heath. After checking to see that all the parts were there, all I needed was a large work space devoid of small children.

A Foam Cabinet?

The first task is to mount the power transformer on the cabinet base. And yes, Virginia, the cabinet is foam (see Photo 1). Heath chose to save weight by using a structural foam cabinet. Structural foam is curious stuff. It has a hard appearance, but is fairly flexible. It's lightweight, sturdy and easy to work with. You'd be hard-pressed to break it. But bang it with a sharp object, and you'll gouge out material.

Before mounting hardware to the base, brass inserts must be implemented in holes provided. The inserts are placed part way into the holes, then heated to melt their way into the foam as shown in Photo 2.

My initial concerns about strength were alleviated when I found I could tighten screws to my heart's content, without stripping the insert out of the foam.

The cabinet top mounts to the base by way of two hinges at the rear. The hinges allow the cabinet top to be raised or removed entirely for circuit access.

Circuit Boards

When you order the H-89, you get:

- a power supply board,
- a video driver board,
- a Z-80-based terminal logic board (prewired),
- a Z-80 CPU board (prewired),
- a cassette tape interface board (prewired),
- a floppy disk controller board (prewired) and
- the floppy disk drive.

So only two circuit boards had to be built—two circuit boards and what seemed like a whole raft of connector cables. The biggest challenge with this kit was trying to hold #22 wire in a connector and solder it at the same time. I ended up with blisters on my fingertips. I suggest that anyone thinking about buying an H-89 invest in a small vice to hold the connector body while you solder.

The Power Supply

The power supply board is straightforward in construction, requiring

Martin Moore (2735 SW 229, Aloha, OR 97006) contributed the article "The 16-Bit Super Processors Are Here" to our August 1980 issue.

only eight diodes, four filter capacitors and three pin connectors. Make sure you double-check the polarity on the diodes and capacitors. The smell of burning caps is so depressing.

The power transistors mount on a large aluminum heat sink that stands alongside the power supply board. For additional cooling, the fan is mounted on the cabinet top right over the power supply.

Once the supply is built, static tests (power off) are performed to see if any large globs of solder were left on the board. If your job passes the static tests, the moment of truth arrives. You plug it in. Fortunately, mine worked the first time.

The power supply provides +65 V to the video driver board, and +18, -18, +5 and +8.5 V to the rest of the boards. The Wangco disk drive gets +5 and +12 V.

Video Driver Board

The video driver board is next. This board requires about three hours of construction time. Once again, if you follow Heath's instructions, you'll have no trouble. All the part locations are clearly marked on the board, so it's difficult to get a component in the wrong spot.

I did have one bit of trouble. The circuit uses quite a few small glass-encapsulated diodes. Theoretically, the manual gives you the part number, and you examine the diodes for that number. They even give you a magnifying glass so you can see the number. In actual fact, it's nearly impossible to see the number printed on the diode. It seemed like I spent most of my time trying to make out what kind of diode I had. If Heath is open to advice, I'd suggest that they wrap all like diodes together and mark the package. That would certainly save on eye strain. As it was, all the components were in one plastic sack, sort of jumbled together.

Circuitry—The video driver board has its own voltage regulator, which produces a stable +53 and +6 V. The +53 V supply is used to elevate the CRT cathode. The video signals from the terminal logic board, after passing through a cascade amplifier, ride on this +53 V level.

The vertical sync square wave from the terminal logic board is shaped to create a sweep ramp signal that is amplified and placed on the vertical yoke of the CRT. A vertical size adjustment in the amplifier will

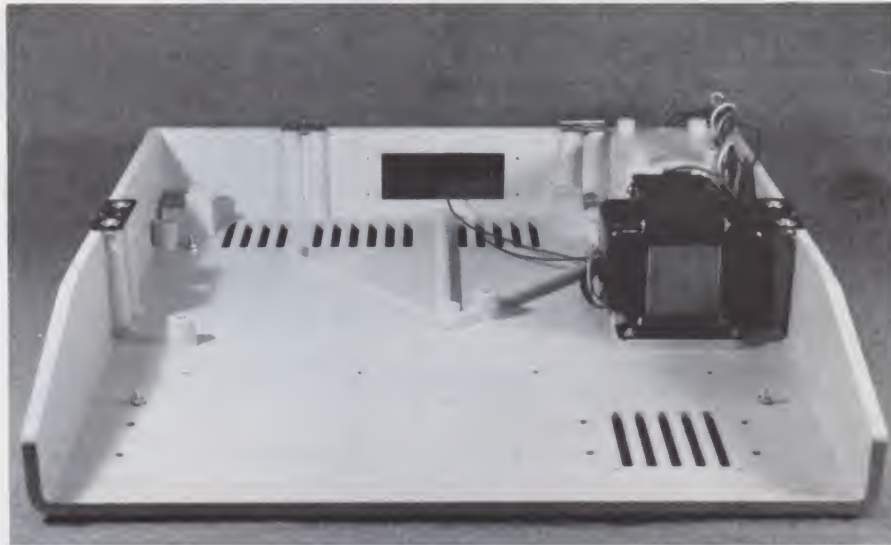


Photo 1. The structural foam base with power supply transformer mounted. The entire H-89 cabinet is made of structural foam.

let you set the vertical height of the display to whatever is comfortable. For me, comfortable was about an inch shorter than the six inches recommended by Heath.

The horizontal sync pulse from the terminal logic board is used to create the +500 V anode voltage for the CRT, as well as control the horizontal deflection of the electron beam.

Placement—The video driver board rests flat in the bottom of the cabinet (Photo 3), mounted to the base by four screws. There's only one problem with this placement, and that occurs later, when you have to slide the cable from the keyboard under the video driver board. It's somewhat difficult to convince the little beggar that it ought to go under there.

Terminal Logic Board

The terminal logic board did not require any work on my part, other than to prepare some more of those countless cables. The terminal logic board is a computer in itself. It has a Z-80 microprocessor, Motorola's 6845 CRT controller, an asynchronous serial port, program ROM, scratchpad RAM and display memory. I'll talk more about the abilities of the terminal later on.

I had one problem with the terminal logic board, and at the time I thought it was my error. The board generates three signals called video, vertical sync and horizontal sync. These three signals are fed to the video driver board (the one I put together).

When I first powered up the H-89, the raster looked horrible. Instead of

white letters on a black background, I was getting white letters on a splotchy gray background. And I could see the retrace zipping across the screen. The problem was fairly obvious—there wasn't enough video signal to create decent contrast. If I backed the brightness down, the characters disappeared. Turn the brightness up, and the screen turned gray.

The oscilloscope told the story. The video driver board was getting nice, fat 5 V signals from the vertical sync and horizontal sync lines, but the video signal was almost nonexistent. Back to the terminal logic board.

Heath uses 74LS86 exclusive-OR devices to drive the video signals. And one of the gates had died. Once I replaced the 74LS86, the display was beautiful—one of the sharpest displays I've seen. Actually, it's a wonder there was any display at all. The



Photo 2. Threaded brass inserts are melted into the foam cabinet. The inserts are used to mount hardware to the cabinet.



Photo 5. The H-89 graphic characters.

keypad lets you do on-screen editing (although none of the Heath software supports this function).^{*} Keys 1 through 9 each have a shifted function that controls the cursor and performs character and line editing jobs. Shifts 4, 8, 6 and 2 move the cursor left, up, right and down, respectively. Shift 3 will delete the cursor line. Shift 7 will let you insert characters, moving all the characters to the right of the cursor to the right of the screen. Shift 9 causes the character at the cursor position to be deleted. And shift 5 homes the cursor to the upper left of the screen.

If you don't want to press the shift key each time you use the cursor controls, the terminal can be placed into a shifted keypad mode by entering ESC t (escape t). This can be done either off-line at the keyboard, or by the computer. This is one of the many escape sequences used to program the keyboard and terminal. ESC t places the keypad into the shifted mode until you tell it otherwise, or shut the H-89 off. Or, if you think you'll want the keypad in the shifted mode most of the time, there's a switch on the terminal logic board that will cause the terminal to power up in the keypad shifted mode. Then you can use ESC u to get out of the shifted mode.

There's a third mode, called the alternate keypad mode, into which the keypad can be programmed. This mode causes the keypad to act much like the programmable keys mentioned before. In the alternate keypad mode, each key sends an unused escape sequence to the computer.

None of these codes are supported in Heath software, but instead rely on a program you write to perform a specific function. This is not to say that Benton Harbor BASIC, Microsoft BASIC or Heath CP/M won't work with these keys. It's just that you have to tell your BASIC program to look out for them. All in all, you get 19 programmable keys with this terminal.

Escape sequences—I mentioned escape sequences in regard to the eight programmable keys and the keypad.

Actually, the whole terminal is controlled with escape sequences, either sent from the computer or entered on the keyboard. The escape sequences do the following:

- ESC p puts the terminal in reverse video mode
- ESC q gets the terminal back out of reverse video
- ESC F puts the terminal in the graphics mode
- ESC G exits the graphics mode
- ESC t places the keypad into its shifted mode
- ESC u exits the shifted mode
- ESC = places the keypad into its alternate mode
- ESC > gets the keypad back to its normal mode
- ESC [puts the terminal into the hold screen mode
- ESC \ exits the hold screen mode

All of the cursor control key actions can be duplicated by the computer with escape sequences. There's an escape sequence for each cursor movement (up, down, backward, forward, home). If the computer sends the terminal an ESC n, the terminal tells the computer where the cursor is with an x-y coordinate. ESC j causes the terminal to save the present location of the cursor, which can be returned to the saved location with an ESC k. And the cursor can be moved directly to a position by entering ESC Y, followed by an x-y coordinate (direct cursor addressing).

All of the editing functions (erase page, erase part of the page, erase a line, insert a line, etc.) can be generated by the computer with an escape sequence.

Escape sequences also let the computer reconfigure the terminal. For example, ESC r lets you set the RS-232C data rate from 110 to 9600 baud. ESC x lets you enable the 25th line, disable the key click, change the cursor from an underline to a block, shut the cursor off and go into any of the shifted or alternate modes. ESC y lets you change everything you set with ESC x. And ESC z resets the whole works to its power-up configuration. It's a very busy terminal!

The one irritating aspect of this

keyboard is that a repeat key is used instead of implementing automatic repeat on each key. If you want multiples of the same character, you have to hold down the repeat key in addition to the character key.

The Screen

The H-89 screen in my machine is of Toshiba origin, and will display 25 lines of 80 characters with true descenders. The screen definition is sharp—you can see each dot in the display's matrix. In fact, trying to blur the screen with the focus control is nearly impossible. I turned the focus control to both stops, and could see very little change in the display. This is a high-quality CRT.

Graphics

The H-89 cannot handle true graphics. Instead, what you get are 33 graphic symbols (see Photo 5). The 33 symbols available are flexible enough to do moderately sophisticated displays, but you simply can't do true, point-to-point graphics work. What's missing is the software in the terminal. I believe the hardware is there, and the screen certainly has enough resolution to handle 2000 point graphics.

But don't despair. I'm sure some enterprising software expert will come up with a ROM package that will let the terminal do its stuff.

The CPU Half

The computer portion of the H-89



Photo 6. The CRT and facade are mounted. The ribbon cable connects to the terminal keyboard.



Photo 7. Nearly complete, the H-89 only requires the 5.25-inch disk drive to be mounted.

is, in all respects, a general-purpose computer. A 2 MHz Z-80 runs the whole affair. The H-89 comes standard with 16K of RAM based at 040,100 (split octal notation). Below this memory space resides the system ROM and the floppy disk ROM and RAM. Heath has reserved 3K of the low memory address space for future use.*

The hardware is already on the board, waiting for another 32K of RAM, which will let you expand to 48K.

There are several I/O ports on the CPU logic board. One port, called the general-purpose port, is for internal use. The general-purpose port tells the computer the state of the configuration DIP switch (baud rate settings, etc.). Another port on the CPU logic board traps on all H8 software instructions that would normally go to the H8 front panel (you can directly run Heath's H8 software on the H-89 without modifications). Since the H-89 doesn't have a front panel, these port accesses are redirected to either do nothing or cause a display on the terminal.

A console port handles serial data transfer to the terminal half of the H-89. And, like the terminal half, the computer uses an 8250 ACE for communications.

The cassette port is actually the place where the cassette interface board plugs in. The cassette port is controlled by firmware in the H-89

system ROM.

The H-89 CPU logic board has room for six accessory circuit boards. Each board plugs into square pins on the CPU logic board. The square pins make up the six parallel I/O ports.

Cassette Tape Interface

When you order the H-89, you get the cassette tape interface with it, whether you want it or not. This seems a little redundant in the face of the floppy disk controller and drive, but that's the way it is.

The cassette interface board converts digital information into a Kansas City-type 1200 Hz/2400 Hz format. The information is recorded and loaded at 1200 baud. The interface can drive two recorders, reading information from one and storing information on the other. Or, you can use just one recorder. When you're loading information onto a tape, the interface board automatically puts a three-second tone on the tape before data transfer begins. The tape operating system looks for this three-second tone when the data is loaded back into the computer.

Another feature of the cassette interface board is that you can reduce the incoming signal by 500 by moving a jumper on the board. The incoming signal is normally about 500 mV peak-to-peak. Installing the jumper reduces the signal to about 1 mV peak-to-peak.

The cassette interface board

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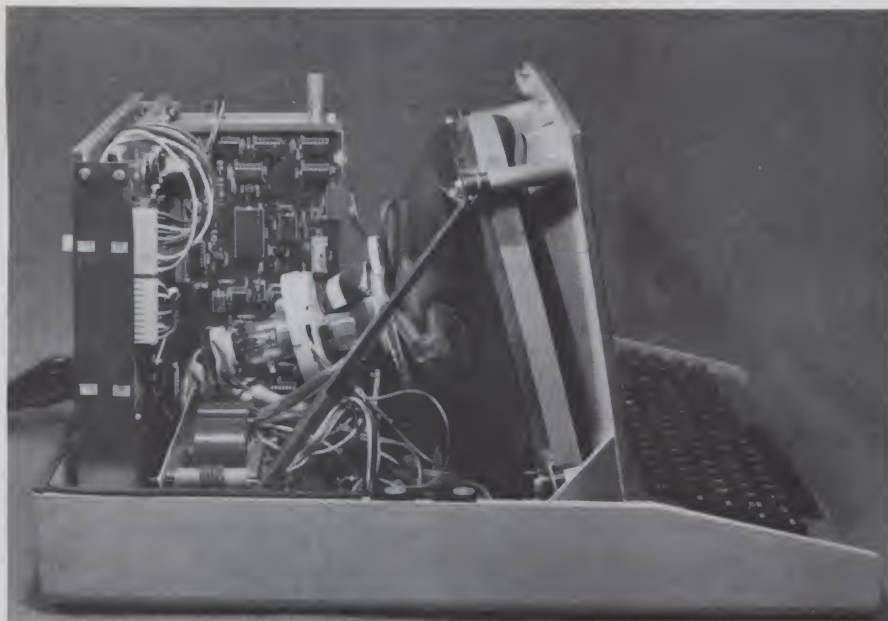


Photo 8. A side view of the H-89. The CPU logic board and terminal logic board run across the rear of the unit. The small board is the cassette interface board. The disk drive is not yet mounted.

mounts onto the CPU logic board. The interface board comes assembled, but you have to put together the cabling from the board to the rear panel.

The LED curiosity—When I mounted the cassette interface board, I noticed an LED lurking around the middle of the board. I looked in the operator's manual to find out about the LED, but was disappointed. It said nothing. The theory of operation was silent on the matter, too.

Well, it turns out that the LED is connected to the input wave shaping circuitry, and indicates whether the information is coming through clearly. If you watch the LED when you're loading information from cassette, you can tell whether the incoming signal is too strong or too weak. If the signal is too strong, the LED glows steadily. If the signal is too weak, the LED doesn't come on at all. A flickering light is just about right. This lets you adjust the volume control on your recorder to the optimum setting.

The Disk Drive and Controller

The drive used in the H-89 is the Model 82 from what used to be the Wangco Division of Perkin-Elmer, before Perkin-Elmer sold the line to Seimens. The drive uses a ten-hole hard-sectored disk, and can store on to 40 tracks. This is a pretty good drive. If you can come up with a controller that will use double-density encoding methods, you can record

double-density. Heath's controller uses single-density recording.

Another nice thing about the drive is that it can be daisy-chained to up to three other drives. That is, you can connect three other drives to the original, without altering the controller board. Heath software currently supports a maximum of three drives. Heath will sell you another two drives with enclosure and power supply for \$895.

The drive is turned off and on by software. This means that you don't have to listen to the drive rotate when it's not doing anything. There is a one-second delay, however, from the time the drive is turned on until it's up to operating speed.

The controller—Heath chose to use an S2350 USRT as the basic controlling element in their disk controller. The S2350 converts the bus parallel data to nonreturn to zero (NRZ) serial data. Other circuitry on the controller converts the NRZ data to the bit cell format required by the drive. The beauty of this controller is its simplicity. No fancy gimmicks or bells and whistles. In other words, not much to go wrong.

Drive calibration—Because the drive is a mechanical device, it will wear with age. One of the things that wears is the drive motor. Rotational speed of the motor must be constant, and must be within set limits. Heath foresaw the need to be able to calibrate the drive motor periodically,

and put a handy little routine in their firmware that calculates the motor's rotational speed. To adjust the drive speed, you pull the drive part way out of the cabinet and turn a potentiometer on the drive, while watching numbers on the H-89 screen.

Firmware/Software —The H-89 Monitor

The H-89 monitor exists in ROM at the bottom 2K of address space.* (This, by the way, is one of the major complaints about the H-89 and H8. A lot of other Z-80 or 8080 computers use software that requires the bottom of memory to be RAM. Heath's monitor precludes easy conversion of other people's software.) The monitor is somewhat primitive, but lets you communicate with the computer without loading external software. You can even enter and execute programs, examine and alter memory, and store and retrieve programs from tape.

When the power is turned on, the H-89 beeps twice, then shows H: on the terminal. The H: is the prompt character. All command entries to the monitor are single-character. The H-89 fills in the rest of the command. For example, if you press "S" (no return required), the terminal will print "SUBSTITUTE." Then it's up to you to enter the address you want to look at or change. The following is a list of monitor commands that can be entered from the keyboard.

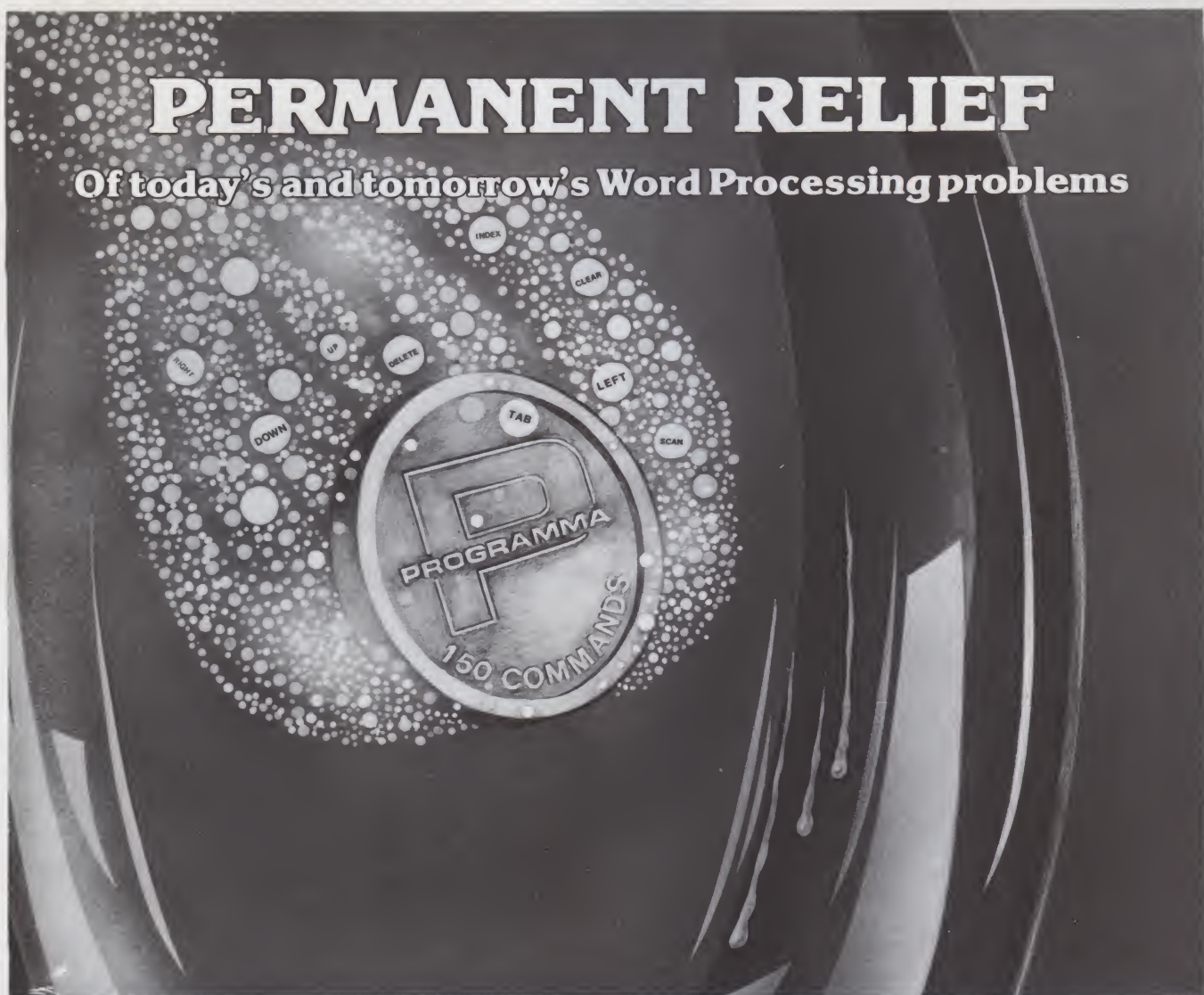
Substitute—This command will let you examine or change a value in RAM. You press "S" and enter the address in split-octal notation. As soon as you've entered the address and pressed return, the monitor places the address and its contents on the terminal screen. At this point, you can change the memory contents, or you can leave them the way they are.

You can look at and change preceding or successive addresses by pushing the dash key or the space bar, respectively. You can quickly cycle through several addresses by holding down the space bar or dash key, and pressing the repeat key. If you want to change a memory value, simply enter the value. If you make a mistake with the first six digits you entered, enter them again. The monitor takes the last value entered. To exit from the SUBSTITUTE command, press return.

Program counter—When you press "P" on the keyboard, the monitor

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Photo 9. The completed H-89. Total construction time was about 20 hours.

writes PROGRAM COUNTER on the display, then waits for your next entry. If you hit return, the monitor shows you the current value of the program counter register. At this point, you can enter a new program counter value, or you can hit return to exit.

Go—Pressing "G" will cause the terminal to display GO. You can either enter the address of the first instruction to be executed, or you can just press return, and the H-89 will begin executing at the address already loaded into the program counter register.

Dump—This command lets you save programs on cassette tape. When you press "D," the terminal prints DUMP and waits for you to enter the address range you want stored. One thing that is saved, aside from the program, is the value of the program counter. If, before you enter the DUMP command, you set the program counter value to the first executable instruction location, the program counter will automatically be set to this value when the program is reloaded into the computer.

While the dump is executing, the addresses stored are displayed on the terminal.

Load—The tape load routine reads information back into the H-89 from the cassette tape. If you have several

programs on one tape, you must position the tape at the beginning of the file you want to load. The monitor can't search for a specific file. While the file is being loaded, the monitor validates the information coming in. If a checksum error is detected, the tape loading will stop and the terminal will beep until you reset the computer. Once a tape file is properly loaded, just press "G" followed by a return, and the program will begin to execute.

That summarizes the basic command set of the H-89 ROM monitor. A couple of utility routines are available in the monitor, including the memory test. The memory test loads each RAM location with a number, then goes back and reads the number to see if it was stored correctly. The test then increments the original number and begins again. All the while the terminal shows you the number being used in the test.

Another test in the monitor is the disk drive rotational speed test mentioned before. ■

Part two of this article, which focuses on software, will appear in the next issue of Microcomputing.

*Heath now offers a modification to the H-88 or H-89 that will allow CP/M to run, based at address 000H.

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Dollars and Sense

By Gene Embry

Listing 1. DOLLAR.PRT program.

```
0001 : DOLLAR.PRT
0002 :
0003 : Gene Embry
0004 :
0080 GOSUB 9800::Pam. variables
0089 :
0100 : Main
0101 :
0110 INPUT "Enter a dollar amount ",N
0112 IF N>9999.99 PRINT"Too large!":GOTO 900
0114 IF N=0 PRINT "Bye!":END
0116 IF N<.01 PRINT "No checks for nesative dollars!":GOTO 900
0118 LET N1=N
0120 LET N=INT(N*100)::this makes cents
0122 LET N$=STR$(N)::string it out
0124 PRINT "*** ";
0126 IF N<100 PRINT " zero ":GOSUB 1000:GOTO 190
0128 LET A$=N$
0132 LET A=LEN(A$)-1
0140 IF A < 1 THEN 190::done
0150 ON A GOSUB 1000,2000,3000,4000,5000
0160 IF F1=1 THEN A=A-1:F1=0
0170 LET A$=RIGHT$(A$,A)
0180 GOTO 132::do it again
0190 PRINT TAB(W);"$ ";N1
0199 :
0900 : Done
0901 :
0910 PRINT
0990 GOTO 100
0999 :
1000 : Cents
1001 :
1010 LET C$=RIGHT$(N$,2)
1020 PRINT "and ";
1030 PRINT C$;"/100 dollars ***";
1090 RETURN
1099 :
2000 : 0 -> 9 dollars
2001 :
2010 LET B$=LEFT$(A$,1)
2020 LET B=VAL(B$)
2030 IF B=0 THEN 2090
2040 PRINT D$(B);" ";
2090 RETURN
2099 :
3000 : Tens' disit
3001 :
3010 LET B$=LEFT$(A$,1)
3012 LET C$=LEFT$(A$,2)
3020 LET B=VAL(B$)
3022 LET C=VAL(C$)
3030 IF B=0 THEN 3090
3032 IF B+C=0 THEN 3090
```

Have you ever wanted to spell out the dollar amount when using your micro to write checks? This routine will let you do just that, using only 27 English words. Add to the vocabulary the words "zero," "dollars," "hundred" and "thousand," and you can print dollar amounts from 1 cent up to \$9999.99.

DOLLAR.PRT is shown here as a stand-alone program, but it can be incorporated into your normal check-writing program.

The program is shown in Listing 1, and a sample run, including several examples, is shown in Listing 2.

The Program

Lines 1-100—First, a call is made to routine 9800 to pick up the program's global variables. The array D\$() is filled with the English words, which are stored as DATA statements in the 9900 section. A word of caution—you must enter the DATA statements in the order shown.

Lines 100-199—This is the main working section. The dollar amount to be converted is entered via line 110. Three limit tests are then performed in lines 112 to 116. You then multiply by 100 so that the amount, N, is now in cents. If the amount is less than \$1, you print "zero," call the "cents" routine (1000) and conclude by jumping to line 190. If the amount is greater than \$1, you use string (A\$) and its length (A) to perform a number of GOSUBs in line

Address correspondence to Gene Embry, Route 1, Box 151-H, Morrisville, NC 27560.

More

Listing 1 continued.

```

3034 IF C<21 THEN F1=1:GOTO 3050
3040 LET C=20+(B-2)
3050 PRINT D$(C);" ";
3090 RETURN
3099 :
4000 : Hundreds' disits
4001 :
4010 LET B%=LEFT$(A$,1)
4012 LET B=VAL(B%)
4020 IF B=0 THEN GOTO 4090
4030 PRINT D$(B);" hundred ";
4090 RETURN
4099 :
5000 : Thousands' disits
5001 :
5010 LET B%=LEFT$(A$,1)
5020 LET B=VAL(B%)
5030 PRINT D$(B);" thousand ";
5090 RETURN
5099 :
9800 : Program Variables
9801 :
9810 LINE= 0::Disables the line lenath Function
9820 LET D=27::this is # of words needed
9822 DIM D$(D)
9830 FOR X=1 TO D
9832 READ D$(X)::the Enslish words
9834 NEXT X
9840 LET W=60::Position where '$ DDD.CC' is printed
9890 RETURN
9899 :
9900 : Data
9901 :
9910 DATA one,two,three,four,five,six,seven,eight,nine,ten
9920 DATA eleven,twelve,thirteen,fourteen,fifteen,sixteen
9930 DATA seventeen,eighteen,nineteen,twenty,thirty,fourty
9940 DATA fifty,sixty,seventy,eishty,ninety

```

```

RUN
Enter a dollar amount ? 1017.56
*** one thousand seventeen and 56/100 dollars ***          $ 1017.56

Enter a dollar amount ? .04
*** zero and 4/100 dollars ***                                $ 0.04

Enter a dollar amount ? 5.96
*** five and 96/100 dollars ***                                $ 5.96

Enter a dollar amount ? 1234.56
*** one thousand two hundred thirty four and 56/100 dollars ***
                                                                $ 1234.56

Enter a dollar amount ? -4.77
No checks for nesative dollars!

Enter a dollar amount ? 999999999
Too large!

Enter a dollar amount ? 0
Bye!

BASIC
#

```

Listing 2. Sample run.

150.

Which subroutine is called is based on the value of A. Each call will decrement A by 1. You continue until the value of A is less than 1, and conclude by printing out the cents in line 190.

Example

Assume that the value entered is

1017.56. The value of N will be evaluated as 101756 by line 120. A\$ will become 101756, with A taking on the value of 5. Since A is equal to 5, line 150 will cause section 5000, the thousands' digit routine, to be called. The LEFT\$ statement in line 5010 assigns a value of 1 to B\$. The value of B\$ is B, which is 1. Line 5030 looks into the

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table D\$(B) and finds the English word one. We print D\$(B) and append thousand.

Upon return we reassign a new value to A\$ via line 170. Its new value is 01756. Then, looping back to line 132, we determine the new value of A is 4 by line 132. Line 150 sends us to routine 4000 to get the English word in the hundreds' position. Since B\$=0 and B will equal 0, we return without doing anything.

Line 170 sets A\$=1756, and we jump back to line 132. Here the value A becomes 3, thus causing us to go to section 3000 to pick up the tens' digit(s).

Since the digits 11 to 19 are uniquely named in English, we must evaluate both the tens' and units' digits at this point. We determine the sum of both digits (B and C) and then take the necessary measures for printing the word from array D\$(). If F1 gets set to 1 upon return, A is decremented one additional time in line 160.

Finally, A has been set to 0, at which time line 140 will cause the program to continue to line 190, which will print the cents. ■



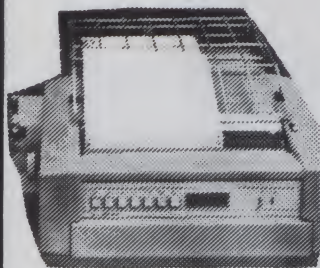
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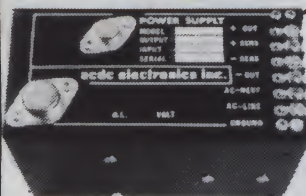
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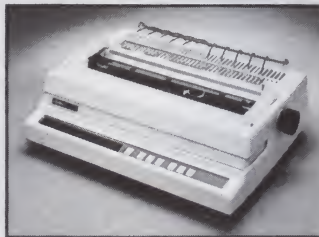
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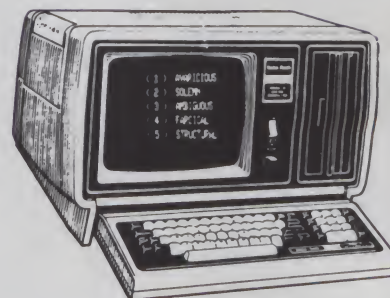
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Write Your Own Pseudo-FORTH Compiler

By Richard Fritzson

This compiler, for a simple threaded language similar to FORTH, extends the interpreter for the language described in "Write Your Own FORTH Interpreter" (*Microcomputing*, February 1981, p. 76). The compiler takes reverse Polish notation statements exactly like those typed into the interpreter along with standard programming language control statements such as IF-THEN-ELSE and FOR-LOOP, compiles them into threaded code and stores them in the dictionary associated with a user-defined name.

The compiler is written almost entirely in threaded code and is simply added to the basic interpreter described in the first article, with only one or two simple modifications to

the already existing code.

I should point out again that although the language being described is similar to FORTH in many ways, it is not really FORTH. It does not conform to the FORTH implementation standards (see references), nor is it the same language sold by FORTH, Inc. I believe that threaded-code-based systems are so inherently flexible that computerists should use them to devise languages which suit them and to perform software experiments. It would be easy for anyone who is interested to modify the system presented here to conform to a given set of standards.

Language Overview

In this language, every program

and subroutine has a name. The traditional name in FORTH for the compiler is a single colon, which introduces a new definition. It is followed by the name of the function being defined, then by the code which comprises the new routine, then finally by a semicolon which terminates the definition. Table 1 contains a few simple examples. (The lowercase text is annotation added after the interaction with the compiler. See the extensions section for suggestions on how to add a comment facility.)

While the typed-in language does not let you use the control statements that most programming languages have, such as GOTO, IF-THEN, etc., not much computing can be done without them. This compiler will handle the standard IF-THEN-ELSE statements, as well as two typical looping statements: the FOR LOOP and the REPEAT LOOP (both similar to the Pascal statements of the same name).

Because all of the functions in this language require their arguments to be on the stack, even these standard control statements are written in reverse Polish notation. This will make them seem strange at first. You can either learn to like this or you can write a better compiler. You'll see that doing the latter is not as hard as you might think.

Even though the language here only supports 16-bit integers for data, we will interpret these numbers as logical values when appropriate by using zero to mean false and nonzero to mean true.

The syntax of the IF statement is shown in Table 2. It is the word IF,

- : ADD + ;	define ADD to be the same as +
0	
- 3 5 ADD	notice the system prints the top of the stack after each interaction
8	
- : R CLEAR 0 ;	define R to CLEAR the stack and push a zero; notice the stack doesn't change until R is executed
8	
- R	
0	
- : ECHOWORD READLINE SCAN POP PRINTS ;	define ECHOWORD to read a line, get one word and print it; notice that definitions may use several lines
0	
- ECHOWORD	executing ECHOWORD; the zero at the end of the echoed word is the value of the stack being printed without a preceding carriage return
HELLO	
HELLOO	
-	typing just a carriage return just gets you the stack value
0	
-	

Table 1. Simple compiler definitions.

Send correspondence to Richard Fritzson, 25 Cal-lodine Ave., Amherst, NY 14226.

condition	IF	word 1 word 2 word 3	the IF statement without the ELSE
	THEN		
condition	IF	word 1 word 2 word 3	the IF statement with the ELSE
	ELSE	word 4 word 5	
	THEN		
- : TEST 5	EQ	IF 1 ELSE 0 THEN ;	definition of a trivial function to replace a 5 with a 1 and all other numbers with a 0.
			EQ is a function which tests the top two elements of the stack and leaves a "true" if they were equal and "false" if not

Table 2. The IF-ELSE-THEN statement.

preceded by code which calculates the condition to be tested, and followed by code to be executed when the condition is true. The code is terminated by "THEN." Optionally, the word ELSE can be inserted before the THEN, followed by code to be executed only when the condition is false.

The "condition" is the top of the stack when the IF is executed. IF pops and examines the top of the stack. If it is false (zero), control transfers to the next instruction after the matching ELSE if there is one, or after the matching THEN if there is no ELSE. The ELSE statement, when encountered during the execution of the code following the IF, causes a jump to the matching THEN statement. Examples are shown in Table 2. Again, the syntax is a bit unusual, but it does follow in a reasonable way from the need to use reverse Polish notation.

The syntax for the REPEAT statement is shown in Table 3. The word REPEAT is followed by the code to be repeated, terminated by the word LOOP. At any point between the REPEAT and the LOOP you can put an UNTIL test which, like IF, pops and examines the top of the stack. If it is true (nonzero), control transfers to the instruction following the LOOP word, exiting the loop. If it is false (zero), execution continues with the next instruction following the UNTIL.

Putting the UNTIL immediately prior to the LOOP simulates the action of Pascal's REPEAT-UNTIL loop. Putting it at the beginning of the

loop and preceding it with a logical NOT statement simulates Pascal's

WHILE-DO loop. Putting the UNTIL anywhere else gives you a flexible, yet still structured, loop instruction. Examples are shown in Table 3.

The FOR statement (Table 4) gives you the indexed iteration found in most programming languages (e.g., the FOR-NEXT loop in BASIC and the DO LOOP in FORTRAN). When FOR is executed, it pops the top value of the stack and uses it as the starting value of the index variable; the second element of the stack is used as the final value. All of the code between the FOR and LOOP words is executed once for each value of the index variable. (Note that in this version the starting and ending values are both positive, and the only increment possible is one.)

Nested FOR LOOPS are allowed to a depth determined by the size of an independent *loop stack* reserved for holding the looping variables. The current value of the index variable is

REPEAT	typical REPEAT LOOP
word1	Words 1, 2, 3, 4 and 5 are executed repeatedly until the top of the stack after word 3 is nonzero.
word2	
word3 UNTIL	
word4	
word5	
LOOP	
- : GETWORD	define GETWORD to READLINEs until SCAN finally returns a word. Remember that SCAN returns true at the top of the stack when it succeeds in finding a word.
REPEAT	
SCAN UNTIL	
READLINE	
LOOP ;	
0	
- : READ# REPEAT	READ# keeps on reading words until one of them can be successfully converted to a number
GETWORD	
CONAXB UNTIL	
POP	
LOOP ;	
0	
- READ#	test READ#
hello	(it just ignores non-numbers)
ss34	
123	
123	(and leaves the number at top)
- : SUM REPEAT	SUM adds all numbers on the stack until it encounters a zero
SWAP	-get second number and duplicate it
DUP	-quit looping if it is zero
EQZ UNTIL	-else add it to next element
+	-and loop
LOOP	-drop the zero leaving the SUM
POP ;	
0	
- 0 1 2 3 4 5 SUM	test SUM
15	
- 0 1 3 5 7 9 SUM	test SUM
25	

Table 3. The REPEAT LOOP.


```

last first FOR
    word1
    word2
    word3
    LOOP

```

The FOR LOOP executes repeatedly for index values from *first* to *last*

```

FOR I = first TO last

```

It is equivalent to the BASIC FOR NEXT loop.

```

NEXT I

```

```

- : SIGMA
    0 SWAP
    1 FOR
        I +
    LOOP ;

```

SIGMA adds the numbers from 1 up to its argument by starting with zero and adding "I" inside a FOR LOOP

```

0
- 3 SIGMA
6
- 10 SIGMA
55

```

test SIGMA

test SIGMA

```

- : 2**N

```

2**N calculates 2 to the N, where N is the top of the stack

```

1
SWAP 1 FOR
    DUP +
    LOOP ;

```

(starting value = 2**0)
(repeat from 1 to N)
(double the number)

```

55
- 5 2**N
32
- 10 2**N
1024
-

```

test 2**N

test 2**N

Table 4. The FOR LOOP.

accessible through the functions I, J and K. "I" puts the value of the index variable on the stack. "J" is used in a nested pair of loops and puts the value of the outer LOOP's index variable on the stack. "K" is used for triply nested FOR LOOPS and puts the value of the outermost (the third) LOOP's index variable onto the stack. Table 4 contains some examples.

The entire language is built of subroutine calls or function names, so of course there is no explicit subroutine CALL or GOSUB statement. There is no GOTO out of respect for the principles of structured programming. These three control structure statements should let you do anything you need. If you really want a GOTO statement, adding one is a little tricky, but possible and maybe worth trying.

One other feature of the language is that it permits recursive definitions of subroutines. Since parameters, local variables, looping indices and return addresses are all on stacks, these

recursive definitions will all work just fine. Table 5 contains some examples; I sometimes find them easier

to write than nonrecursive statements. However, you must remember that recursive programs consume return stack space, so you cannot use them to replace looping all of the time (unless you have a lot of return stack space).

Compiler Design

To make the compiler easy to modify and expand, it is as structured as possible. The operation of the main compiler routine is described by the algorithm in Table 6.

For most words of the language—the names of the subroutines in the dictionary—the only compiler action is to store the address of the subroutine in the compiled code (since that is all there is to threaded code). When number constants appear inside a definition, the compiler stores code that, when executed, pushes the number onto the stack (the same way the interpreter pushes numbers on the stack when you type them in). Of course, numbers that are defined as constants in the dictionary are handled in the same way as other entries in the dictionary; the compiler just stores the address of the entry. All of the special compiler language words such as IF, REPEAT, semicolon, etc., are stored in a special dictionary, and the action taken for each is defined as a separate subroutine associated with the dictionary entry.

The organization of the separate dictionary is shown in Table 7. Although the names of the compiler's words are separate from the names of

```

- : SUM

```

the recursive definition of SUM does the same thing as the iterative: it adds the numbers on the stack until it encounters a zero

```

SWAP DUP EQZ IF
    POP
    ELSE
        +
        SUM
    THEN ;

```

(test if second element is a zero)
(if yes, then drop it)
(else add the top two numbers)
(and SUM the result and the rest)

```

0
- 0 4 3 5 5 7 SUM
24
- : GETWORD
    SCAN EQZ IF
        READLINE
        GETWORD
    THEN ;

```

a recursive definition of GETWORD
(scan current line, if scan fails)
(then READLINE)
(and call GETWORD)

```

24
-

```

Table 5. Some simple recursive definitions.

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```

1) Set Compiler Flag to zero
2) Read the Function Name
3) Store the Name and Code pointer in the NAMES section of the dictionary
4) Store a threaded code call (TCALL) as the first word of the compiled definition
5) REPEAT
    Get the Next Word (ignoring line boundaries)
    IF it is a compiler word (e.g., IF, REPEAT, etc.)
    THEN
        Execute it
    ELSE
        IF it is defined in the dictionary
        THEN
            Store its address in the code
        ELSE
            IF it is a number
            THEN
                store a push instruction
                store the number
            ELSE
                Error—abort compilation
    UNTIL the Compiler Flag is not zero

```

Table 6. The compiler algorithm.

the interpreter's words, the code for both types of entries is intermixed. The compiler part of the dictionary is stored at the top of memory to let the interpreter expand the other part more easily. It would not be difficult to write a program that moved these dictionary parts around and allowed you to expand the compiler (adding, for example, new control statements) in the same way you expand the interpreter.

One reason the compiler is so simple is that it does not do any syntax checking. This means that most syntactic errors will simply cause the compiler to generate bad code. One simple check that is not too difficult to add is to make sure that all of the REPEATs are balanced with UNTILs and LOOPS, that every FOR has a LOOP, that every IF has a THEN and every ELSE has a matching IF-THEN. This only requires that you keep count of the different statements.

A more interesting and more difficult check would be to see to it that no control statement crossed over the boundary of another. For instance, no FOR LOOP can begin inside an IF statement but end outside. Notice that you can't make a REPEAT LOOP begin inside a FOR LOOP but end outside; the compiler will interpret it in the correct way.

As we'll see, compiling code for the IF-THEN-ELSE and REPEAT-LOOP is easy; they're just conditional jumps. The FOR-LOOP, however, requires a bit of work because there is so much to be done for one. The first

time the FOR is executed, the numbers on the parameter stack have to

be moved to the special loop stack. On each iteration the index variable (on the loop stack) has to be incremented and compared with the final value (also on the loop stack). If it exceeds the final value, the numbers have to be cleared off the loop stack and control transferred to the next instruction after the LOOP.

This whole set of operations is so common to computer programs that some computers have hardware instructions for it (e.g., the Z-80 has a "decrement B and jump if the result is not zero") to make things easy for the compiler and to speed up execution of the loop. For just those reasons we handle this by adding to our threaded code interpreter two new primitives: one for initializing a FOR LOOP and one for incrementing and testing the index variable.

Implementation: The Main Compiler Routine

Listing 1a contains the main compiler routine as it would look if it

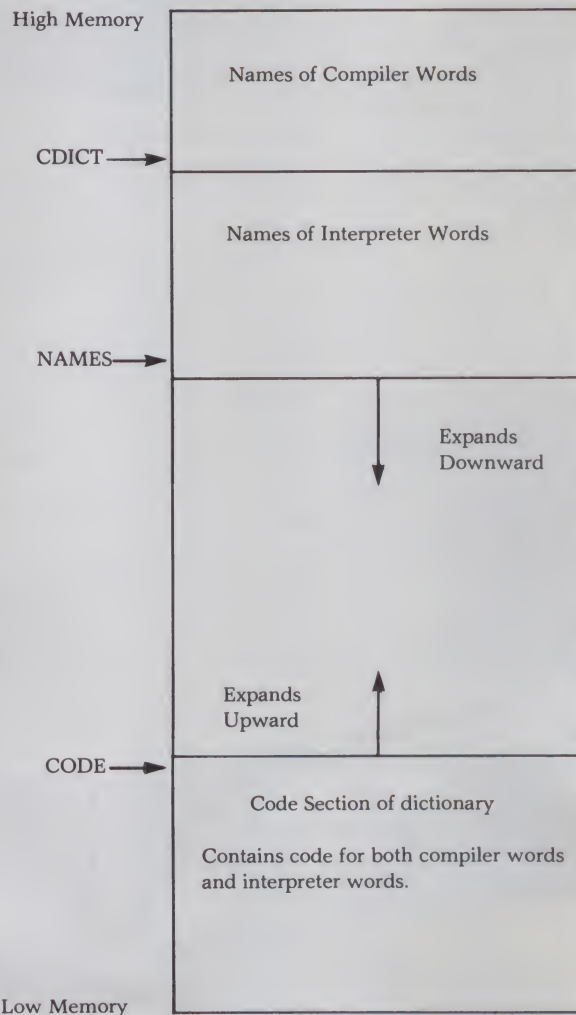


Table 7. Organization of memory. For dictionary details see Fig. 15 of part 1.

- ::		redefining the colon
0 CFLAG POKEW		set compiler flag to zero
GETWORD		read the function name
ENTER		and enter it into the dictionary
@TCALL CMPLW		compile the address of the TCALL code
		(NOTE: @TCALL is a CONSTANT; see text)
REPEAT		
GETWORD		get next function word
CDICT PEEKW		get start of compiler word dictionary
LOOKUP		and lookup the word
IF		
EXECUTE		if found, execute it
ELSE		else
NAMES PEEKW		look in the interpreter's dictionary
LOOKUP		
IF		
CMPLW		if found, compile the word into the code
ELSE		
CONAXB		else try interpreting it as a number
IF		
@PUSH CMPLW		if successful, store a PUSH instruction
CMPLW		and the number itself
ELSE		
CERROR		otherwise issue an error
THEN		
THEN		
CFLAG PEEKW UNTIL		check the compiler flag
LOOP		and continue compiling until it is true

Listing 1a. The main compiler routine. This function was not actually typed in. Not all of the words used here are defined in the code. It is for illustrative purposes only. However, there is no reason that it cannot be made to work.

Listing 1b. Interactive threaded code compiler.

```

; Interactive Threaded Code Compiler
;
; This is the interactive compiler routine. Its
; name in the dictionary is ":" (a colon). It
; is called with the following syntax:
;
; - : NAME FN1 FN2
;   FN3 FN4 ... FNN ;
;
; where name is the name of the new function being
; compiled and FN1 through FNN are the
; words which make up the new function. The
; final semicolon terminates the definition.
; This code is not optimized, but is exactly
; what would be produced if it were compiled by
; itself.

COMPILE
03C3 4702          DW      TCALL          ;threaded code CALL
03C5 6C034703BD    DW      ZERO,CFLAG,POKEW ;clear the compile flag
03CB 53035C05      DW      GETWORD,ENTER    ;get and store name
03CF C7024702B3    DW      TPUSH,TCALL,CMPLW ;compile threaded call

03D5 5303          COMPL1 DW      GETWORD    ;get next word
03D7 6804AB022E    DW      CDICT,PEEKW,LOOKUP ;look in compiler dict
03DD 0503E603      DW      IFZ,COMPL2-1      ;if not found
03E1 9104          DW      EXECUTE          ;else execute
03E3 F5021004      DW      JUMP,COMPL5-1      ;and continue

03E7 6004AB022E    DW      NAMES,PEEKW,LOOKUP ;look in interpreter dict
03ED 0503F603      DW      IFZ,COMPL3-1      ;if not found
03F1 B305          DW      CMPLW            ;else store in definition
03F3 F5021004      DW      JUMP,COMPL5-1      ;and continue

03F7 8508          COMPL3 DW      CONAXB      ;try interpreting as a num
03F9 05030804      DW      IFZ,COMPL4-1      ;if not
03FD C702C702B3    DW      TPUSH,TPUSH,CMPLW ;else compile code to
0403 B305          DW      CMPLW            ;push the number
0405 F5021004      DW      JUMP,COMPL5-1      ;and continue

0409 A307          COMPL4 DW      PRINTS      ;print the string
040B C7021F04      DW      TPUSH,CUMSG      ;push error message

```

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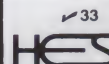
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Listing 1b continued.

```

040F EB05          DW      UERROR          ;compiler error routine

0411 4703AB02      COMPL5 DW      CFLAG,PEEKW      ;check compiler flag
0415 18031C04      DW      IFNZ,COMPL6-1          ;if not zero, quit
0419 F502D403      DW      JUMP,COMPL1-1          ;else continue

041D 5B02          COMPL6 DW      TRET           ;return when done

041F 0E20697320CUMSG DB      14,' is undefined.'
                     PAGE

```

were typed into itself. Listing 1b shows what it would be compiled into and how it is actually written in the assembly-language kernel of the interpreter.

In order to let us use the LOOKUP function written for the interpreter, a small modification needs to be made to it. This change makes the beginning of the dictionary a parameter of the LOOKUP routine. The interpreter has to be changed to provide this parameter on the stack. Listing 2 highlights these changes. Since each section of the dictionary ends with a zero byte, the LOOKUP function will not run on beyond the end of the interpreter's section of the dictionary into the compiler's section.

Listing 3 contains the function ENTER, which stores a string into the interpreter's dictionary. It assumes that the code address for the dictionary entry is the current end of the code section of the dictionary because that is where the next compiled definition will go. Notice that the two halves of the dictionary—the names section and the code section—are allowed to grow toward each other until they meet just as described in the interpreter article; testing for this collision is performed both in ENTER and in the routine for adding code to the code section of the dictionary.

```

; Top Level External Interpreter Version 1.0
;
; This routine reads one line of reverse
; polish notation from the console and executes it.
;
; Version 1.5: The code has been modified to provide
; LOOKUP with the address of the beginning of the
; interpreter dictionary.
INTERACT
0381 4702          DW      TCALL           ;threaded code

0383 9507          DW      PROMPT          ;prompt the user and
0385 9904          DW      READLINE        ;read a console line

0387 E407          SLOOP DW      SCAN       ;scan for next word
0389 0503AC03      DW      IFZ,EXIT-1      ;if end of line, quit
038D 6004AB02      DW      NAMES,PEEKW     ;else lookup word in
0391 2E04          DW      LOOKUP          ;interpreter dictionary
0393 05039C03      DW      IFZ,NUMBER-1    ;if not found, try number

0397 9104          DW      EXECUTE         ;else execute it
0399 F5028603      DW      JUMP,SLOOP-1    ;and continue scanning

039D 8508          NUMBER DW      CONAXB    ;try converting to binary number
039F 18038603      DW      IFNZ,SLOOP-1    ;if succesful, leave on stack
                                         ;and continue scanning

03A3 C702B503      DW      TPUSH,ERRMSG    ;else push error message
03A7 A307          DW      PRINTS          ;and print it
03A9 A307          DW      PRINTS          ;then print string
03AB 5B02          DW      TRET           ;and return

03AD E5023108      EXIT  DW      DUP,CONBXA ;copy and convert top of stack
03B1 A307          DW      PRINTS          ;print it
03B3 5B02          DW      TRET           ;return

03B5 0D4E6F7420ERRMSG DB 13,'Not Defined: '
                     PAGE

```

Listing 2a. Top level external interpreter, version 1.0.

Implementation: The Semicolon

The semicolon is in FORTH what the END statement is in BASIC; it tells the compiler that the subroutine definition is finished. The actions taken by ";" (Listing 4) are: 1) a threaded code return (TRET) is stored at the end of the code being compiled, and 2) a flag is set, causing the compiler to exit its main loop.

Implementation: IF-ELSE-THEN

The IF statement is a conditional forward GOTO. When an IF statement is compiled, it stores a conditional jump-if-zero (i.e., *skip this code if false*) instruction (a threaded code jump instruction, not a machine-language instruction) but leaves the address to be jumped to as a zero temporarily. *The address of the word which contains this zero (the second half of the jump instruction) is pushed onto the stack so that it can be used later.* Listing 5 contains all of the code for the IF, THEN and ELSE statements. It is written in threaded code.

The THEN statement serves as a target for the forward jump left by the IF. The compiler routine for

```

; LOOKUP - the dictionary lookup routine
; ENTRY: TOP - pointer to top of dictionary
; TOP-1 - pointer to string to be looked up
; EXIT: TOP - -1 if string found in dictionary
;         0 if string not found
;         TOP-1 - pointer to code of found subroutine
;         or
;         string pointer if not found
; DESCRIPTION: performs a linear search of the
; dictionary. Returns the code address if the string
; is found, or else the string pointer if not found.
;
; Version 1.5: This routine has been modified to
; accept the dictionary address as a parameter.
042E 4702          LOOKUP DW      TCALL           ;threaded code

0430 E502A102      SEARCH DW      DUP,PEEKB    ;get character count of next entry
0434 05034B04      DW      IFZ,FAIL-1        ;if end of dictionary

0438 6C04          DW      MATCH            ;else attempt a match
043A 18035104      DW      IFNZ,SUCCEED-1    ;if succesful match

043E C1077E02      DW      FIRST,TADD        ;else skip string
0442 C70202007E    DW      TPUSH,2,TADD      ;and pointer
0448 F5022F04      DW      JUMP,SEARCH-1     ;and try next entry

044C D702          FAIL  DW      TPOP         ;drop dictionary pointer
044E 6C03          DW      ZERO            ;leave a zero on the stack
0450 5B02          DW      TRET           ;and quit

0452 DD02D702      SUCCEED DW      SWAP,TPOP   ;drop string pointer
0456 C1077E02AB    DW      FIRST,TADD,PEEKW  ;get code pointer
045C 7403          DW      NEGONE          ;push a minus one
045E 5B02          DW      TRET           ;and return
                     PAGE

```

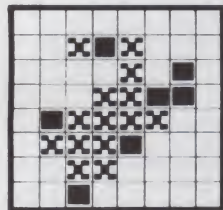
Listing 2b. The dictionary lookup routine.

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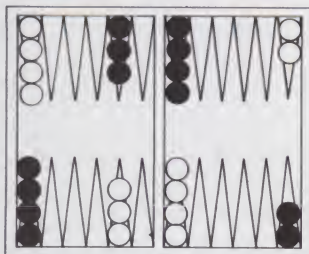


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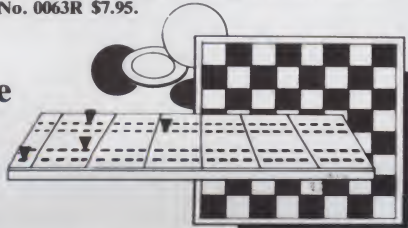
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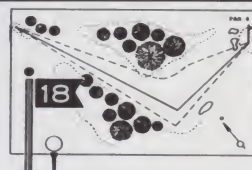
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```

; ENTER - enter a name in the dictionary
; ENTRY: TOP - pointer to name
; EXIT: No Values Returned
; DESCRIPTION: Moves the name up to the name section of
; the interpreter's dictionary. Produces an error
; if there is no room.
055C 4702 ENTER DW TCALL ;threaded code
055E 6404AB02 DW CODE,PEEKW ;store code address for
0562 6004AB02 DW NAMES,PEEKW ;new dictionary entry
0566 76027602BD DW DEC,DEC,POKEW ;(in word below current name point
056C E502A102 DW DUP,PEEKW ;get the string length
0570 E5026E026E DW DUP,INC,INC,INC ;add 3 giving entry length
0578 6004AB02 DW NAMES,PEEKW ;subtract from current beginning
057C DD029902 DW SWAP,TSUB ;of NAMES giving new beginning
0580 E5026404AB DW DUP,CODE,PEEKW ;compare with CODE
0586 DD02330399 DW SWAP,IFGT,EERROR-1 ;if memory full, then error
058C E5026004BD DW DUP,NAMES,POKEW ;else store new beginning
0592 DD026E02F7 DW SWAP,INC,MVBYTES ;and move string to it
0598 5B02 DW TRET

059A C702A205 EERROR DW TPUSH,EEMSG ;print bad news
059E D905 DW ERROR
05A0 5B02 DW TRET

05A2 0F44696374EEMSG DB 15,'Dictionary Full',0DH
PAGE

```

Listing 3. Enter a name in the dictionary.

```

; SEMI - the semicolon - end compilation
; DESCRIPTION: compiles a threaded code return and sets
; the compiler flag to -1.
06A3 4702 SEMI DW TCALL ;threaded code
06A5 C7025B02B3 DW TPUSH,TRET,CMLPW ;compile a TRET
06AB 74034703BD DW NEGONE,CFLAG,POKEW ;signal end of compilation
06B1 5B02 DW TRET
PAGE

```

Listing 4. Code for the semicolon.

```

; Compiler Vocabulary

; IF - skip code if false
; EXIT: TOP - address of middle of jump instruction
; DESCRIPTION: compiles a jump-if-zero saving
; the address of the destination address on the
; stack.
060D 4702 IFX DW TCALL ;threaded code
060F C7020503B3 DW TPUSH,IFZ,CMLPW ;compile conditional jump
0615 6404AB02 DW CODE,PEEKW ;save next address
0619 6C03B305 DW ZERO,CMLPW ;compile a zero temporarily
061D 5B02 DW TRET

; THEN - target for IF and ELSE jumps
; ENTRY: TOP - Address of second half of jump
; instruction to be modified
; DESCRIPTION: stores the address of the next code
; word to be compiled in the jump instruction addressed
; by the top of the stack.
061F 4702 THEN DW TCALL ;threaded code
0621 6404AB0276 DW CODE,PEEKW,DEC ;get next CODE address
0627 DD02BD02 DW SWAP,POKEW ;store in jump instruction
062B 5B02 DW TRET

; ELSE - unconditional skip to THEN; target for IF jumps
; ENTRY: TOP - Address of second half of jump
; instruction to be modified.
; EXIT: TOP - Address of second half of jump
; instruction to be modified (new jump)
; DESCRIPTION: compiles and unconditional jump saving
; the address of the destination address on the stack.
; Stores the address of the next code word to be compiled
; in the jump instruction addressed by the top of the stack.
062D 4702 ELSEX DW TCALL ;threaded code
062F C702F502B3 DW TPUSH,JUMP,CMLPW ;compile unconditional jump
0635 6404AB02 DW CODE,PEEKW ;save address of next word
0639 6C03B305 DW ZERO,CMLPW ;compile a zero temporarily
063D DD02 DW SWAP ;get address of IF jump
063F 6404AB0276 DW CODE,PEEKW,DEC ;get next CODE address
0645 DD02BD02 DW SWAP,POKEW ;store in IF jump
0649 5B02 DW TRET
PAGE

```

Listing 5. Compiler vocabulary.

THEN does not compile any new code, but instead uses the address left on the stack by IF to complete the forward jump by storing there the address of the next word of code to be compiled.

The ELSE statement uses a combination of the IF code and the THEN code. It completes the IF's forward jump in the same way as the THEN statement—so that when an ELSE is present, IF only jumps as far as the ELSE and not all the way to the THEN. However, in order to make the "true" code skip over the "false" code, ELSE also compiles an unconditional jump and leaves the address of the second word of the jump on the stack. In this way, the IF and the ELSE leave identical stack conditions, and the THEN doesn't have to worry about whether the optional ELSE appeared or not.

Implementation: REPEAT - UNTIL - LOOP

The conditional looping routines work in almost the same way as the IF-ELSE-THEN routines. The REPEAT statement is only a target for a backwards jump from the LOOP statement. It doesn't compile any code, but simply leaves the address of the next word to be compiled on the stack. The UNTIL statement, which is not optional, compiles a conditional jump-if-not-zero and, like the IF statement, leaves the address to jump to as zero and the address of the second half of the jump on the stack.

When the LOOP statement is executed, there are two words on the stack: the address of the second half of the forward jump (left by UNTIL) and the address of the beginning of the loop (left by REPEAT). The LOOP routine compiles an unconditional jump back to the REPEAT statement and completes the forward jump of the UNTIL statement so that it jumps past the LOOP. This code is shown in Listing 6.

The use of the stack to store jump addresses is all done during compilation and has no effect on parameter passing at run time. It allows nesting of the IF-THEN, REPEAT and FOR constructions to a depth which is limited only by the size of the parameter stack and will work fine as long as each statement is balanced and properly constructed. As mentioned earlier, syntax errors will not cause compiler errors but will result in the generation of bad code as, for example, the THEN statement completing a


```

; REPEAT - target for LOOP instruction
; EXIT: TOP - address of end of CODE
; DESCRIPTION: simply leaves address of next CODE
; instruction on the stack.

064B 4702 REPEAT DW TCALL ;threaded code
064D 6404AB0276 DW CODE,PEEKW,DEC ;get CODE address
0653 5B02 DW TRET

; UNTIL - terminate LOOP if true
; EXIT: TOP - address of middle of jump instruction
; to be filled in by LOOP.
; DESCRIPTION: Compiles a conditional jump-if-not-zero
; leaving the address of the destination address on the stack
; to be filled in by the LOOP instruction.

0655 4702 UNTIL DW TCALL ;threaded code
0657 C7021803B3 DW TPUSH,IFNZ,CMLPW ;compile conditional jump
065D 6404AB02 DW CODE,PEEKW ;save address of next word
0661 6C03B305 DW ZERO,CMLPW ;compile a zero temporarily
0665 5B02 DW TRET

; LOOP - target for UNTIL; unconditional return to REPEAT
; ENTRY: TOP - address of UNTIL jump
; TOP-1 - address of REPEAT location
; DESCRIPTION: compiles an unconditional jump to the
; location of the REPEAT word; points the UNTIL jump
; to the next CODE word to be compiled.

0667 4702 LOOP DW TCALL ;threaded code
0669 C702F502B3 DW TPUSH,JUMP,CMLPW ;compile unconditional jump
066F DD02B305 DW SWAP,CMLPW ;to repeat
0673 6404AB0276 DW CODE,PEEKW,DEC ;get next CODE word
0679 DD02BD02 DW SWAP,POKEW ;and complete UNTIL jump
067D 5B02 DW TRET
PAGE

```

Listing 6. REPEAT—target for LOOP instruction.

jump set up by an UNTIL, or some similar confusion.

Implementation: FOR-LOOP

As mentioned before, to keep the

FOR and LOOP code simple, we introduce two new primitive instructions into the threaded code interpreter: the initialize FOR loop instruction (FORINIT) and the incre-

ment and test instruction (FORTEST). Both of these use a new interpreter stack (recall that we already have two: the parameter stack and the return address stack), the LOOP stack (Listing 7). It is implemented in the same way as the return stack (the stack pointer is kept in memory) and is used to store the current and final values of the loop variable.

FORINIT, since it is simple and only executed once for each use of the FOR LOOP, is written in threaded code (Listing 8). It pushes onto the loop stack one less than the starting value of the index variable (so that the first increment and test instruction will bump it to its proper starting value) and one more than the final value of the loop variable (so that the test for termination is a test for equality rather than a greater than test).

FORTEST is written in machine code so that it will execute quickly. It pops the two numbers off of the loop stack, increments the index variable and compares it to the terminating value. If they are equal, it leaves a nonzero quantity on the stack; if they are not equal, it pushes both values

```

; LPUSHX - push top of stack on loop stack
; ENTRY: DE - number to go to loop stack
; EXIT: No Values Returned
; DESCRIPTION: Pushes DE on the loop stack.

0734 2A5307 LPUSHX LHLD LSTACK ;get stack pointer
0737 73 MOV M,E ;store low byte
0738 23 INX H ;bump stack pointer
0739 72 MOV M,D ;store high byte
073A 23 INX H ;bump stack pointer
073B 225307 SHLD LSTACK ;restore pointer
073E C9 RET

; LPUSH - push top of stack on loop stack
; DESCRIPTION: This is the threaded code callable
; version of LPUSHX.

073F 4107 LPUSH DW S+2 ;machine code
0741 D1 POP D ;get value
0742 CD3407 CALL LPUSHX ;push it
0745 C33702 JMP NEXT

; LPOPX - pop loop stack
; ENTRY: No Values Expected
; EXIT: DE - former top of loop stack
; DESCRIPTION: Pops loop stack to DE

0748 2A5307 LPOPX LHLD LSTACK ;get stack pointer
074B 2B DCX H ;dec to hi byte
074C 56 MOV D,M ;retrieve
074D 2B DCX H ;dec to low byte
074E 5E MOV E,M ;retrieve
074F 225307 SHLD LSTACK ;restore stack pointer
0752 C9 RET

; LSTACK - the loop stack
; DESCRIPTION: Implemented in the same way as the return stack.
; The stack pointer points to the next available location.

0753 5507 LSTACK DW S+2
0755 DS 64 ;good for 16 levels of nested loops
PAGE

```

Listing 7. LPUSHX—push top of stack on loop stack.

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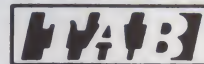
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- : CONSTANT	GETWORD ENTER	read the next word and enter it into the dictionary
	CONS CMPLW	compile a pointer to CONSTANT code and compile the constant's value
0		
- : VARIABLE	GETWORD ENTER	read the next word and enter it
	VARBL CMPLW	compile pointer to VARIABLE code and compile initial value
0		
- 10 CONSTANT TEN		define TEN to be the constant 10
0		
- TEN		
10		
- TEN TEN +		
20		
- 13 VARIABLE UNLUCKY		define UNLUCKY to be a variable with the initial value 13
20		
- UNLUCKY		variables return their addresses
2433		
- UNLUCKY PEEKW		you have to "peek" their values
13		
- 7 UNLUCKY POKEW		and "poke" changes to them
13		
- UNLUCKY PEEKW		
7		
- : ? PEEKW ;		of course you don't have to be verbose about it
7		
- UNLUCKY ?		
7		
-		

Table 8. CONSTANTS and VARIABLES.

back on the loop stack and leaves a zero on the stack.

These two primitives make the compilation of the FOR LOOP quite simple. FOR compiles a call to FOR-INIT and a call to FORTEST, leaving the address of the FORTEST instruction on the stack to serve as a target for the jump from LOOP. It also compiles a jump-if-not-zero after the FORTEST and leaves the address of the second half of the jump on the stack (Listing 9).

Notice that the stack conditions left by FOR are the same as those left by REPEAT and UNTIL. Therefore, the same LOOP code can be used for both loops. LOOP compiles an unconditional jump back to the FORTEST instruction and completes the forward jump which follows it with the address of the word to be compiled after LOOP.

Implementation: I, J and K

The instructions which access the current value of the index variable of the FOR LOOP are not compiler instructions. They are regular threaded-code instructions which access the contents of the loop stack; the compiler simply compiles their address. Listing 10 shows their definitions. Notice that they access every other word on the loop stack, skipping the terminating values. It should be clear how to add more of these words if they are needed.

Implementation: CONSTANTS and VARIABLES

The interpreter article introduced a trick for implementing variables and constants in a threaded language; you create an entry with a special type of function which either loads a constant onto the stack or loads the address of a variable. Since, while typing new programs into the compiler, you will probably want to introduce new variables and constants, you need a way to enter these definitions for them.

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- 0 VARIABLE TEMP	define a temporary variable
0	
- : *	define a multiplication operator
DUP TEMP POKEW	- save the multiplicand
SWAP 2 FOR	- repeat the loop one less than the value of the multiplier times
TEMP PEEKW +	- just add the multiplicand to the running total
LOOP ;	NOTE: This is a very inefficient algorithm and is here just for fun
0	
- 10 10 *	test *
100	
- 3 4 *	
12	
- R	clear the stack
0	
- : FAC	an iterative definition of factorial
DUP EQZ IF	
POP 1	if argument is zero then value is 1
ELSE	
1 SWAP 1 FOR	else it is the product of all numbers
I *	
LOOP	between N and 1
THEN ;	
0	
- 6 FAC	test FAC
720	
- 0 FAC	
1	
- : FAC	factorial can be defined recursively
DUP EQZ IF	
POP 1	if argument is zero then value is 1
ELSE	else call
DUP DEC FAC	FAC with one less than the argument
*	and multiply result with argument
THEN ;	
1	
- 3 FAC	
6	

Table 9.

equivalent of compiler declarations for these new words. The word **CONSTANT** (Table 8) takes an argument from the top of the stack and reads the next word from the console and makes that word the name of a dictionary entry which points to a type **CONSTANT** function whose value is the number on the stack.

The word **variable** works in exactly the same way but compiles its entry as type **VARIABLE**. The number on the stack is the initial value of the **VARIABLE**.

Notice that the words **CONSTANT** and **VARIABLE** are not part of the assembly-language kernel; they are definitions typed into the compiler. Although they could just as easily have been put into the kernel, and it was necessary to define extra constants in the kernel (**CONS** and **VARBL**) that give the addresses of the **CONSTANT** and **VARIABLE** type code, I think they give an interesting illustration of what the compiler is capable of doing along these lines.

That's the whole compiler. Table 9 contains a few more examples of function definitions using **CONSTANTS** and **VARIABLES**, including some contrasting **LOOPing** and recursive definitions. Listing 11 contains all the loose end routines not defined earlier. Table 10 contains a glossary of all the words defined in the kernel. This is useful to maintain as you add words and write new definitions, since it helps to keep you from rewriting functions which already exist and makes it easier to use them as well.

Listing 8. **FOR LOOP** auxiliary definitions.

```

; FOR LOOP Auxiliary Definitions

; FORINIT - initialize a FOR LOOP
; ENTRY: TOP - starting value of loop index
;       TOP-1 - final value for loop index
; EXIT: No Values Returned
; DESCRIPTION: pushes the final value plus one
; and the starting value minus one onto the loop stack.

06DB 4702 FORINIT DW TCALL ;threaded code because not critical
06DD DD026E023F DW SWAP,INC,LPUSH ;final value
06E3 76023F07 DW DEC,LPUSH ;starting value
06E7 5B02 DW TRET

; FORTEST - increment and test FOR LOOP index variable
; ENTRY: No Values Expected
; EXIT: TOP - -1 if index variable has exceeded final value
;       TOP - 0 if index variable is still below final value
; DESCRIPTION: increments index variable (found on top of
; loop stack) and compares it with final value plus one (next
; number on loop stack). If equal, it leaves the values off
; of the loop stack and returns a -1 indicating termination of
; the loop otherwise it puts the values back on the loop stack
; and returns a zero.

06E9 EB06 FORTEST DW $+2 ;machine code for efficiency
06EB CD4807 CALL LPOPX ;get index variable
06EE 13 INX D ;and increment it
06EF D5 PUSH D ;get final value
06F0 CD4807 CALL LPOPX ;DE <- final value
06F3 E1 POP H ;HL <- index variable
06F4 E5 PUSH H
06F5 CD9102 CALL MINUSH ;subtract
06F8 19 DAD D

```

More

Extensions

I kept the code presented in these two articles as simple as possible to avoid complicating the explanations; as a result, it is far from perfect. Although it does run as described, it is lacking in a few respects, most notably error checking. Overstacking or overpopping the stacks will result in catastrophic failure of the system and unpredictable occurrences. If you make extensive use of this code, you will undoubtedly want to add as much of this kind of checking as you can. Additional necessary improvements include interfacing the code to your operating system or mass storage devices, so that you can store definitions on tape or floppy disk and load them when you want them.

Another useful feature is the ability to add comments to your definitions. **FORTH** defines the compiler word

Listing 8 continued.

```

06F9 7C      MOV    A,H
06FA B5      ORA    L
06FB CA0C07  JZ     ENDFOR ;if equal

06FE CD3407  CALL    LPUSHX ;else put final value back
0701 D1      POP     D ;and put index variable back
0702 CD3407  CALL    LPUSHX
0705 210000  LXI     H,0 ;return a zero
0708 E5      PUSH    H
0709 C33702  JMP     NEXT

070C E1      ENDFOR POP    H ;clear stack
070D 21FFFF  LXI     H,-1 ;return a minus one
0710 E5      PUSH    H
0711 C33702  JMP     NEXT
PAGE

```

"(' (a left parenthesis) to be "read and ignore everything until the next right parenthesis," which permits comments to appear anywhere. Another method is to choose a single character, for example, a percent sign, and define it to be READLINE. This causes everything after it on the line to be skipped over.

Other extensions include adding a third parameter to the FOR LOOP to

permit increments of the index variable other than one. You can do this directly or rewrite the code associated with FOR and make the increment an argument of the word LOOP (renamed to be distinct from the LOOP used with REPEAT). Words for performing more extensive reordering of the top three or four words on the stack are very useful (the use of the variable in the definition of the multi-

ply operation in Table 9 would not have been necessary with a few of these). More extensive primitives for output are not hard to add. There is really no end to what can be done with this type of code. ■

References

As mentioned in the beginning, this language is not FORTH. If you are interested in the real FORTH, or if you don't want to start your system from scratch, here are some useful sources:

- The FORTH Interest Group, PO Box 1105, San Carlos, CA 94070. These people sell a variety of FORTH literature and products including a source listing of a FORTH interpreter (for six popular CPUs) and an installation manual. They also publish a newsletter.

- "FORTH for Microcomputers," by John James, in *Dr. Dobb's Journal of Computer Calisthenics and Orthodontia*. Vol. 3, Issue 5. An introduction to standard FORTH including an explanation of how FORTH is usually interfaced to disks and CRT screens. A reprint is available from the FORTH Interest Group for \$2.

:	the compiler
+	add top to top-1
-	subtract top from top-1
/MOD	divide top-1 by top, leave quotient at top-1 and remainder at top
INC	add one to top
DEC	subtract one from top
MINUS	negate top
EQ	if top = top-1, replace it with -1, else replace it with 0
EQZ	if top = 0, replace it with -1, else replace it with 0
I	push innermost FOR loop index
J	push second FOR loop index
K	push third FOR loop index
CLEAR	pop all elements off of the stack
POP	pop the top element off of the stack
SWAP	swap top and top-1
DUP	duplicate the top element of the stack leaving it at both top and top-1
READLINE	read a line from the console into the console buffer
SCAN	extract a word from the console buffer, leave a pointer to it at top-1, with -1 at top, or just 0 if end of line
PEEKB	replace top with byte located at (top)
PEEKW	replace top with word located at (top)
POKEB	replace byte at (top) with top-1; drop top and top-1
POKEW	replace word at (top) with top-1; drop top and top-1
PRINTS	print the string pointed to by top
CONBXA	convert binary number at top to ASCII string; leave a pointer to the string
CONAXB	try to convert ASCII string pointed to by top to binary number; leave value and -1 if successful, 0 if not
MATCH	compare two strings pointed to by top and top-1; leave string pointers plus true if same, false if not
LOOKUP	lookup string in dictionary, leave pointer to entry and true if found, else pointer to string and false
ENTER	enter string in dictionary; causes error if dictionary overflows
CMPLW	enter 16-bit word into code section of dictionary; causes error if dictionary overflows
MVBYTES	move a block of (top) bytes from (top-2) to (top-1)
EXECUTE	execute routine located at (top)
MEMORY	variable, value = top of available memory
CONS	constant, value = address of CONSTANT code
VARBL	constant, value = address of VARIABLE code

Table 10. Glossary of interpreter words.



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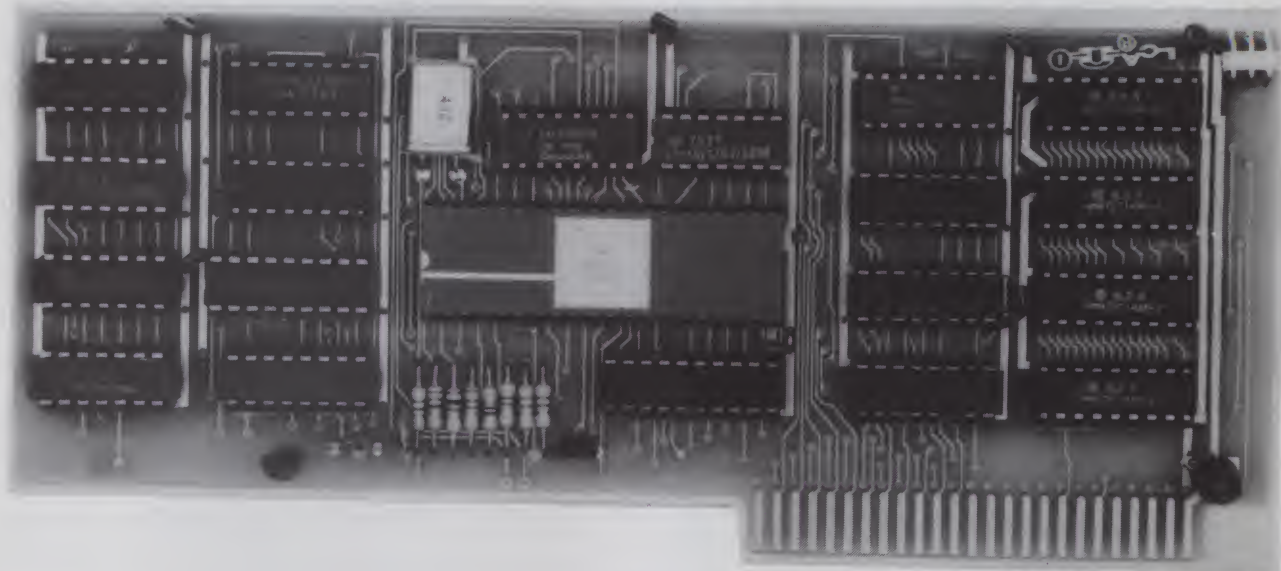
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```

; FOR - compile beginning of FOR loop
; EXIT: TOP - address of middle of conditional jump
;           to be filled in by LOOP
;           TOP-1 - address of FORTEST instruction, the
;                 beginning of the FOR loop
; DESCRIPTION: Compiles FORINIT and FORTEST instructions.
; Follows the FORTEST with a jump-if-not-zero. Leaves the
; address of the FORTEST instruction and the address of
; the second word of the conditional jump instruction
; on the stack to be used by LOOP. Notice that the stack
; is left in the same condition a REPEAT and UNTIL would
; have left it in.

```

```

067F 4702    FOR      DW      TCALL      ;threaded code
0681 C702DB06B3    DW      TPUSH,FORINIT,CMLW      ;compile FORINIT
0687 6404AB0276    DW      CODE,PEEKW,DEC      ;save next address
068D C702E906B3    DW      TPUSH,FORTEST,CMLW      ;compile FORTEST
0693 C7021803B3    DW      TPUSH,IFNZ,CMLW      ;compile conditional jump
0699 6404AB02      DW      CODE,PEEKW      ;save next address
069D 6C03B305      DW      ZERO,CMLW      ;compile a zero temporarily
06A1 5B02          DW      TRET

```

Listing 9. FOR—compile beginning of FOR loop.

```

; FOR LOOP Index Variables
; The following functions implement the words I, J and K wh
; lookup the current value of the index variable for the innermost
; second and outermost FOR LOOPS.

```

```

; I, J, K - FOR LOOP index Variables
; ENTRY: No Values Expected
; EXIT: TOP - value of index variable
; DESCRIPTION: performs a table lookup on the Loop Stack.
; 'I' selects the first element on the stack, 'J' selects
; the third and 'K' selects the fifth. (Every other
; element contains the terminating value of the loop variable.)

```

```

0714 1607      XI      DW      $+2      ;machine code
0716 11FFFF      LXI     D,-1      ;1st element for I
0719 C32907      JMP      XN
071C 1E07      XJ      DW      $+2      ;machine code
071E 11FDFF      LXI     D,-3      ;3rd element for J
0721 C32907      JMP      XN
0724 2607      XK      DW      $+2      ;machine code
0726 11FBFF      LXI     D,-5      ;5th element for K
0729 2A5307      XN      LHLD     LSTACK ;get loop stack pointer
072C 19          DAD      D          ;offset to desired element
072D 56          MOV      D,M        ;DE ← element
072E 2B          DCX      H
072F 5E          MOV      E,M
0730 D5          PUSH     D          ;stack the value
0731 C33702      JMP      NEXT
0732 PMGE

```

Listing 10. FOR LOOP index variables.

Listing 11a. New additions to compiler version.

```

; New Additions to Compiler Version
; IFGT - jump if TOP-1 > TOP
;
; Version 1.5 new function
0333 3503      IFGT     DW      $+2      ;CODE
0335 D1          POP      D          ;DE ← TOP
0336 E1          POP      H          ;HL ← TOP-1
0337 CD4003      CALL     SUB16      ;HL ← TOP-1 - TOP
033A D2F702      JNC      JUMP1      ;jump if TOP is smaller
033D C30D03      JMP      SKIP      ;otherwise don't
; SUB16 - 16 bit subtraction
; ENTRY: HL - subtrahend
; DE - the other one
; EXIT: HL - 16 difference (HL-DE)
; Carry set if HL<DE
; REGISTER USE: A PSW
0340 7D          SUB16    MOV      A,L
0341 93          SUB      E
0342 6F          MOV      L,A
0343 7C          MOV      A,H
0344 9A          SBB      D
0345 67          MOV      H,A
0346 C9          RET

```

```

; CFLAG - local variable for compiler
; DESCRIPTION: set to zero at initiation of compile loop,

```

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Listing 11a continued.

```

; set to -1 by semicolon and error routines to signal the
; end of compilation.

0347 7C03      CFLAG   DW      VARIABLE
0349 0000                      0

034B 6303      CONADD  DW      CONSTANT      ;address of CONSTANT code
034D 6303                      DW      CONSTANT
034F 6303      VARADD  DW      CONSTANT      ;address of VARIABLE code
0351 7C03                      DW      VARIABLE

; GETWORD - get a word from input
; ENTRY: No Parameters expected
; EXIT: TOP - pointer to a word read from console
; DESCRIPTION: Uses SCAN to retrieve next word on
; line. If there is no next word, reads a line
; from the console and uses SCAN again.

0353 4702      GETWORD DW      TCALL          ;threaded code

0355 E407      GW1     DW      SCAN            ;get next word
0357 18036003  DW      IFNZ,GW2-1          ;if gotten
035B 9904      DW      READLINE           ;else read a line
035D F5025403  DW      JUMP,GW1-1         ;and try again
0361 5B02      GW2     DW      TRET
                                PAGE

```

; Stack Tests

; These auxiliary functions test the stack for conditions
; similar to those tested by the conditional jumps. They leave
; the results of their tests on the stack (True = -1, False = 0)
; for testing by IF or UNTIL. Tests like these replace the conditional
; jumps in the compiler language which has no GOTO statements.
; The functions are written in machine language for efficiency
; since they tend to be executed frequently.

; EQ - test if TOP = TOP-1

; DESCRIPTION: Pops the top two elements of the stack and replaces
; them with a -1 if they were equal or a zero if they were not.

```

06B3 B506      EQX     DW      $+2          ;CODE
06B5 E1         POP     H                  ;get TOP
06B6 D1         POP     D                  ;get TOP-1
06B7 CD4003     CALL    SUB16             ;subtract
06BA 7C         MOV     A,H               ;test for zero
06BB B5         ORA     L
06BC 210000     LXI     H,0               ;anticipate false
06BF C2C506     JNZ     EQX1             ;if not equal
06C2 21FFFF     LXI     H,-1             ;else return true
06C5 E5         EQX1   PUSH    H           ;stack the answer
06C6 C33702     JMP     NEXT             ;and continue

```

; EQZ - test if TOP = 0

; DESCRIPTION: Pops the top of the stack and replaces it with
; a -1 if it was zero or a zero if it was not.

```

06C9 CB06      EQZ     DW      $+2          ;CODE
06CB E1         POP     H                  ;get TOP
06CC 7C         MOV     A,H               ;test for zero
06CD B5         ORA     L
06CE 210000     LXI     H,0               ;anticipate false
06D1 C2D706     JNZ     EQZ1             ;if not zero
06D4 21FFFF     LXI     H,-1             ;else return true
06D7 E5         EQZ1   PUSH    H           ;stack the answer
06D8 C33702     JMP     NEXT
                                PAGE

```

Listing 11b. Stack tests.

Listing 11c. CMLPW—compile a word of code.

; CMLPW - compile a word of code
; ENTRY: TOP - 16 bit word to be compiled
; EXIT: No Values Returned
; DESCRIPTION: Stores the word in the code section
; of the dictionary. Updates the CODE pointer.
; Yields an error if the dictionary is full.

```

05B3 4702      CMLPW   DW      TCALL          ;threaded code
05B5 6404AB02E5 DW      CODE,PEEKW,DUP,INC,INC ;add two to code
05BF E5026004AB DW      DUP,NAMES,PEEKW ;compare with names
05C5 3303D005   DW      IFGT,CERROR-1 ;if memory full
05C9 6404BD02   DW      CODE,POKEW ;else store new code pointer
05CD BD02       DW      POKEW ;and compile word
05CF 5B02       DW      TRET

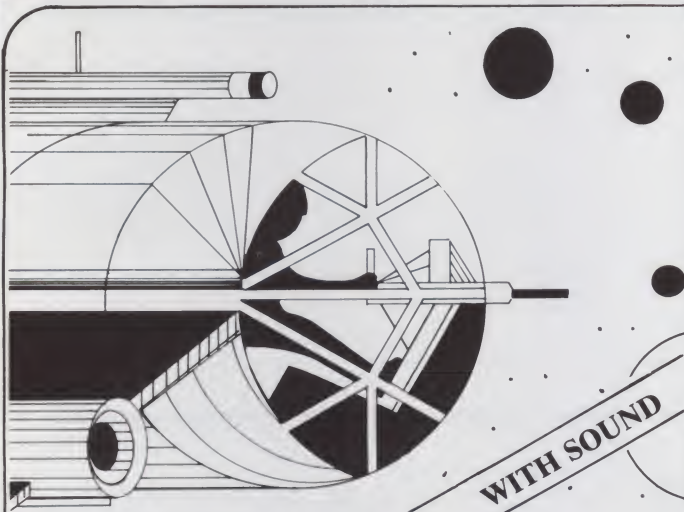
05D1 C702A205   CERROR DW      TPUSH,EEMSG ;print bad new
05D5 EB05       DW      UERROR

```

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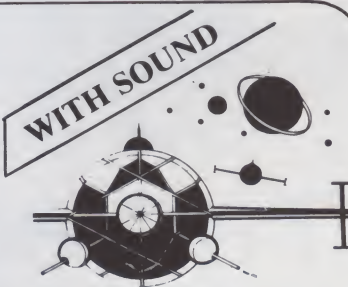
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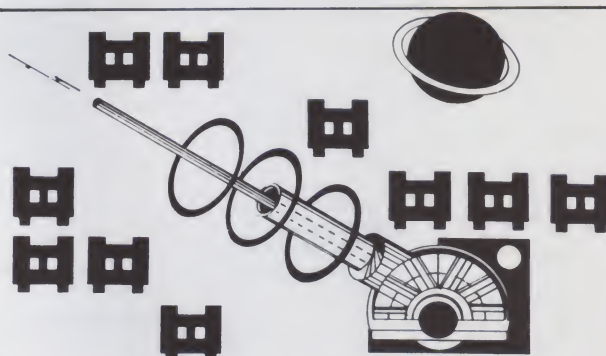
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Listing 11c continued.

```
05D7 5B02          DW      TRET

; ERROR - error during compilation
; ENTRY: TOP      - pointer to error message
; DESCRIPTION: Prints message and aborts compilation

05D9 4702          ERROR   DW      TCALL          ;threaded code
05DB A307          DW      PRINTS          ;print message
05DD 74034703BD    DW      NEGONE,CFLAG,POKEW    ;abort compilation
05E3 7403F504B5    DW      NEGONE,CONBUF,POKEB    ;skip remainder of input 1
05E9 5B02          DW      TRET

; UERROR - 'UNDO' ERROR
; DESCRIPTION: same as ERROR but first 'undoes' the
; partially completed compilation.

05EB 4702          UERROR  DW      TCALL          ;threaded code
;reset NAMES pointer
05ED 6004AB02E5    DW      NAMES,PEEKW,DUP ;current names pointer
05F3 A1027E02      DW      PEEKB,TADD ;plus length of string
05F7 6E02E5026E    DW      INC,DUP,INC,INC ;plus three(save ptr to old CODE)
05FF 6004BD02      DW      NAMES,POKEW ;gives new names pointer
;reset CODE pointer
0603 AB02          DW      PEEKW ;code pointer for aborted entry
0605 6404BD02      DW      CODE,POKEW ;replace current code pointer
0609 D905          DW      ERROR ;normal error
060B 5B02          DW      TRET
PAGE
```

```
; System Variables

; Names - address of interpreter dictionary names

0460 7C03          NAMES   DW      VARIABLE ;threaded code variable
0462 0909          DW      NAMEBEG ;beginning of names

; CODE - address of the dictionary code section

0464 7C03          CODE    DW      VARIABLE
0466 0909          DW      NAMEBEG ;assembles just before names

; CDICT - address of compiler dictionary names

0468 7C03          CDICT   DW      VARIABLE
046A 0C0A          DW      CNAME
PAGE
```

Listing 11d. System variables.

```
; MVBYTES - move a block of bytes forward
; ENTRY: TOP      - byte count
; TOP-1 - target address
; TOP-2 - source address
; EXIT: No Values Returned
; DESCRIPTION: Moves the block of bytes beginnin
; at the source address to the target address.

08F7 F908          MVBYTES DW      $+2 ;CODE subroutine
08F9 C1            POP      B ;BC <- count
08FA D1            POP      D ;DE <- target
08FB E1            POP      H ;HL <- source

08FC 7E            MVB1     MOV      A,M ;get next byte
08FD 12            STAX     D ;store it
08FE 23            INX      H ;bump source pointer
08FF 13            INX      D ;bump target pointer
0900 0B            DCX      B ;decrement count
0901 78            MOV      A,B ;test for zero
0902 B1            ORA      C
0903 C2FC08         JNZ      MVB1
0906 C33702         JMP      NEXT ;exit when finished
PAGE
```

Listing 11e. MVBYTES—move a block of bytes forward.

Listing 11f. The names in the dictionary.

```
; The Names in the dictionary
; Notice that the actual printed names are chosen for typing
; convenience and do not necessarily match the internal names
; which must conform to the assembler's rules. Also, not all
```

More

Listing 11f continued.

```

; functions have been included here.

0909 = NAMEBEG EQU $ ;BEGINNING OF INTERPRETER DICTIONARY
0909 013A DB 1,':' ;note that the compiler is a word in the
090B C303 DW COMPILE ;interpreter's dictionary

090D 012B DB 1, '+' ;arithmetic words
090F 7E02 DW TADD
0911 012D DB 1, '-'
0913 9902 DW TSUB
0915 042F4D4F44 DB 4, '/MOD' ;(not '/'; yields quotient and remainder)
091A BC08 DW DIV
091C 03494E43 DB 3, 'INC'
0920 6E02 DW INC
0922 03444543 DB 3, 'DEC'
0926 7602 DW DEC
0928 054D494E55 DB 5, 'MINUS'
092E 8702 DW MINUS
0930 024551 DB 2, 'EQ' ;stack tests
0933 B306 DW EQX
0935 0345515A DB 3, 'EQZ'
0939 C906 DW EQZ
093B 0149 DB 1, 'I' ;FOR LOOP index values
093D 1407 DW XI
093F 014A DB 1, 'J'
0941 1C07 DW XJ
0943 014B DB 1, 'K'
0945 2407 DW XK
0947 05434C4541 DB 5, 'CLEAR' ;stack manipulating words
094D ED02 DW CLEAR
094F 03504F50 DB 3, 'POP'
0953 D702 DW TPOP
0955 0453574150 DB 4, 'SWAP'
095A DD02 DW SWAP
095C 03445550 DB 3, 'DUP'
0960 E502 DW DUP
0962 0546495253 DB 5, 'FIRST'
0968 C107 DW FIRST
096A 055045454B DB 5, 'PEEKW'
0970 AB02 DW PEEKW
0972 055045454B DB 5, 'PEEKB'
0978 A102 DW PEEKB
097A 05504F4B45 DB 5, 'POKEW'
0980 BD02 DW POKEW
0982 05504F4B45 DB 5, 'POKEB'
0988 B502 DW POKEB

PAGE
098A 0852454144 DB 8, 'READLINE' ;soe input/output words
0993 9904 DW READLINE
0995 045343414E DB 4, 'SCAN'
099A E407 DW SCAN
099C 065052494E DB 6, 'PRINTS'
09A3 A307 DW PRINTS
09A5 06434F4E41 DB 6, 'CONAXB'
09AC 8508 DW CONAXB
09AE 06434F4E42 DB 6, 'CONBXA'
09B5 3108 DW CONBXA
09B7 054D415443 DB 5, 'MATCH' ;miscellaneous
09BD 6C04 DW MATCH
09BF 064C4F4F4B DB 6, 'LOOKUP'
09C6 2E04 DW LOOKUP
09C8 05454E5445 DB 5, 'ENTER' ;enter word in dictionary
09CE 5C05 DW ENTER
09D0 05434D504C DB 5, 'CMLPW' ;compile a word of code
09D6 B305 DW CMLPW
09D8 0445584543 DB 4, 'EXEC'
09DD 1901 DW EXEC
09DF 074D564259 DB 7, 'MVBYTES'
09E7 F708 DW MVBYTES
09E9 0745584543 DB 7, 'EXECUTE'
09F1 9104 DW EXECUTE
09F3 064D454D4F DB 6, 'MEMORY' ;VARIABLE; value=top of memory
09FA 7803 DW MEMORY
09FC 04434F4E53 DB 4, 'CONS' ;CONSTANT; value=address of CONSTANT code
0A01 4B03 DW CONADD
0A03 0556415242 DB 5, 'VARBL' ;CONSTANT; value=address of VARIABLE code
0A09 4F03 DW VARADD
0A0B 00 DB 0 ;END OF INTERPRETER DICTIONARY

;BEGINNING OF COMPILER DICTIONARY

0A0C = CNAME EQU $
0A0C 024946 DB 2, 'IF'
0A0F 0D06 DW IFX
0A11 045448454E DB 4, 'THEN'
0A16 1F06 DW THEN
0A18 04454C5345 DB 4, 'ELSE'
0A1D 2D06 DW ELSEX
0A1F 0652455045 DB 6, 'REPEAT'
0A26 4B06 DW REPEAT
0A28 0554E5449 DB 5, 'UNTIL'
0A2E 5506 DW UNTIL
0A30 044C4F4F50 DB 4, 'LOOP'
0A35 6706 DW LOOP
0A37 03464F52 DB 3, 'FOR'
0A3B 7F06 DW FOR
0A3D 013B DB 1, ';'
0A3F A306 DW SEMI
0A41 00 DB 0 ;END OF COMPILER DICTIONARY

0A41 = NAMEEND EQU $-1
0139 = DICSIZE EQU NAMEEND-NAMEBEG-1 ;dicsize in bytes
0130 = IDICSIZ EQU CNAME-NAMEBEG ;inter dicsize in bytes

```

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```
; Initialization Code
; Executed at start up of sytem but eventually overwritten
; by the expanding dictionary

; DICMOVE - move the dictionary names to the top of available memo

0A42 2A7A03    DICMOVE LHL    MEMORY+2    ;DE <- top of memory
0A45 EB        XCHG      H,NAMEEND    ;HL <-source
0A46 21410A    LXI        B,DICSIZE    ;BC <- byte count
0A49 013901    LXI        B,DICSIZE
```

```
0A4C 7E        DIC1      MOV      A,M    ;transfer loop
0A4D 12        STAX      D              ;get next byte
0A4E 2B        DCX       H              ;move it
0A4F 1B        DCX       D              ;dec source pointer
0A50 0B        DCX       B              ;dec target pointer
0A51 78        MOV      A,B              ;dec count
0A52 B1        ORA       C              ;test for zero
0A53 C24C0A    JNZ       DIC1
```

```
0A56 EB        XCHG      ;set dictionary variables
0A57 23        INX       H
0A58 226204    SHLD      NAMES+2
0A5B 110301    LXI        D,IDICSIZ
0A5E 19        DAD       D
0A5F 226A04    SHLD      CDICT+2
0A62 C9        RET
0A63
```

Listing 11g. Initialization code.

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Cheap, Dumb Apple

By Bill Hubbard

Have you ever wanted to use your Apple as a dumb terminal? This article describes an inexpensive way to do it.

Normally, you'd need a modem costing about \$200 and an interface board for another \$200. But the Electronic Systems Modem (part 109) costs \$27.50. Two recent *Microcomputing* articles describe how to do it [January 1980, p. 52, and February 1980, p. 168].

Now that the high cost of modems has been circumvented, what about an interface? I used the Apple's game paddle connector. You can drive a printer or Teletype from there.

The simple serial output section in the *Apple Red Book* has details about this. But it doesn't tell you how to come back in. The game paddle connector is a two-way street, so if you had a driver program to read one of the game switches as serial ASCII, you could display it on the screen. See listings.

The only additional hardware you'll need is a 16-pin DIP carrier, a 1/4 A mini-fuse and two 100 ohm resistors. A minor enhancement is a 3k resistor and an LED to give a visual indication of the incoming signal. See Fig. 1.

This version uses TTL signals both from the Apple's AN0 output and into its SW2 input. It uses the Apple's 5-volt power supply. I used a slightly different phone connection. Results have been good. See Fig. 2.

To use it, just enter the program by hand, cassette or disk, and from monitor mode type 300 G. All subsequent keyboard characters will modulate the phone line and be displayed. Incoming characters should show up as plain English on your screen. The cursor and all monitor functions are disabled until you hit the reset key.

The driver program resides at locations 300 through 35C and can easily be keyed in by hand and saved to disk or cassette. It consists of an idle loop to continuously check keyboard and input switch, an input routine and an output routine. Mini-assembler and hex listings are included.

This program works only at 110

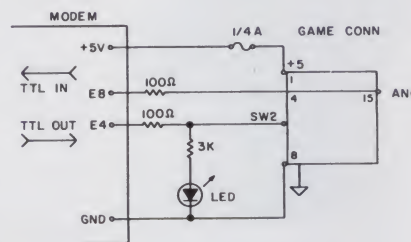


Fig. 1. Connections from inexpensive modem to the Apple game paddle connector allowing it to be used as a timeshare terminal.

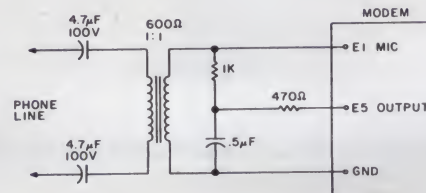


Fig. 2. Simple method of connecting modem directly to phone line.

300	LDA	C000	Keybd
303	BPL	030B	
305	JMP	0339	Output
308	STA	C010	Clear
30B	LDA	C063	Ck Sw
30E	BMI	0300	Loop
310	LDY	#\$08	Bits
312	LDA	#\$25	1/2 bit
314	JSR	FCA8	Wait
317	LDA	C063	Re Ck Sw
31A	BMI	0300	False?
31C	PHA		Save Char
31D	LDA	#\$3B	1 bit
31F	JSR	FCA8	Wait
322	LDA	C063	Ck Sw
325	BPL	032B	Skip
327	SEC		Mark
328	JMP	032C	Skip
32B	CLC		Space
32C	PLA		Pull Char
32D	ROR		Rotate
32E	DEY		Dec Bit
32F	BNE	031C	Done?
331	ORA	#\$80	Hi Bit
333	JSR	FDF0	Display
336	JMP	0300	Loop
339	STA	03FF	Save Char
33C	LDY	#\$0B	11 Bits
33E	CLC		
33F	PHA		Push Char
340	BCS	0347	Skip
342	STA	C058	Space
345	BCC	034A	Skip
347	STA	C059	Mark
34A	LDA	#\$3A	1 bit
34C	JSR	FCA8	Wait
34F	PLA		Pull Char
350	ROR		Rotate
351	DEY		Dec Bit
352	BNE	033F	Done?
354	STA	C010	Clear
357	LDA	03FF	Get Char
35A	JMP	0331	Go Display

Assembly listing of dumb terminal driver.

Correspondence concerning this article should be addressed to Bill Hubbard, 2204 Manlyn Road, Richmond, VA 23229.

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300 AD 00 C0 10 06 4C 39 03
308 8D 10 C0 AD 63 C0 30 F0
310 A0 08 A9 25 20 A8 FC AD
318 63 C0 30 E4 48 A9 3B 20
320 A8 FC AD 63 C0 10 04 38
328 4C 2C 03 18 68 6A 88 D0
330 EB 09 80 20 F0 FD 4C 00
338 03 8D FF 03 A0 0B 18 48
340 B0 05 8D 58 C0 90 03 8D
348 59 C0 A9 3A 20 A8 FC 68
350 6A 88 D0 EB 8D 10 C0 AD
358 FF 03 4C 31 03 00 00 00
  
```

Hex listing of dumb terminal driver.

baud, only in uppercase ASCII, only in half duplex and only in originate mode. After all, it's only a cheap, dumb Apple. ■

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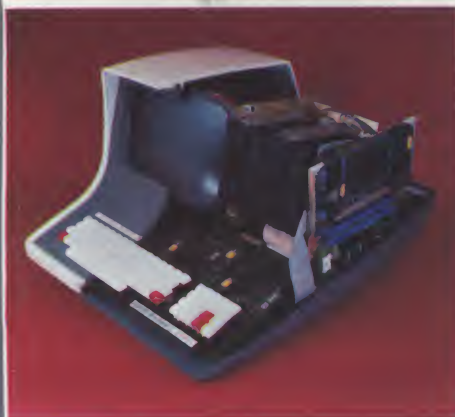
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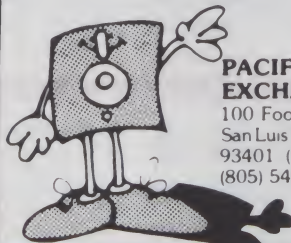
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grams that are begun by executing a text file are rare in my collection, I did not feel it worth the trouble to add this ability. However, it should be fairly simple to do. The logic in line 100 should be changed to check for a "B" or a "T." Then a new line must be added which goes to either existing line 110 or a new one which EXEC's A\$. Also, line 60 must be modified to prevent the "text" warning from being printed.

Since I wrote Auto-menu, I have used the SCRN technique in several other programs. There are undoubtedly many applications for this ability to easily access the contents of the display screen. I would enjoy hearing from anyone who uses this method in other situations. ■

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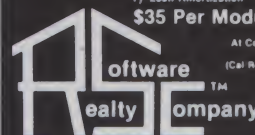
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Meet the Electric Crayon

By Michael B. Roberts

Looking for low-cost color graphics for your computer? The Electric Crayon by Percom could be just what you need.

This versatile unit offers ten software-selectable display modes ranging from an alphanumerics mode, which displays 16 lines of 32 characters via a built-in character generator, to a full graphics mode, which displays 192 rows of 256 points. Up to eight colors can be used, depending on the mode selected.

An on-board 6802 microprocessor executes a graphics control program

contained in read-only memory, accepting commands from a keyboard or computer connected to one of the two dual I/O ports. Commands can be input to erase the screen, set display mode and color, plot points, draw horizontal and vertical lines and load machine-language programs or data into the Electric Crayon's memory.

Description

The Electric Crayon is housed in an attractive metal enclosure measuring 9 x 12 x 2.5 inches (23 x 30.5 x 6.4 cm).

The circuitry is contained on a single printed circuit board mounted to the bottom of the cabinet. Two card-edge connectors for the I/O ports extend through slots in the rear of the cabinet. The rear panel also contains the power switch, fuse holder, power cord and an F61 coaxial connector for the video output.

The heart of the unit is the Motorola MC6847 video display generator (VDG) and its friend, the MC1372 chroma and video modulator. The MC6847 reads picture information from the Crayon's on-board random access display memory and translates it into a video signal which is sent to the MC1372. Eight control inputs to the VDG provide mode and color selection under software control for the picture elements in the display. The MC6847 includes an internal character generator that can display 64 ASCII uppercase letters, numerals and symbols in two colors and inverse video (black characters on a colored background).

The MC1372 converts the display information from the VDG into a composite video signal, which is then fed to a monitor. As supplied, the video output from the Electric Crayon will drive a video input on a monitor or modified TV receiver. Instructions are furnished for easily converting the output to a modulated video carrier on UHF channels 33-40. A

Michael B. Roberts, 681 Overland Ave., Cincinnati, OH 45226.



The Electric Crayon exposed.

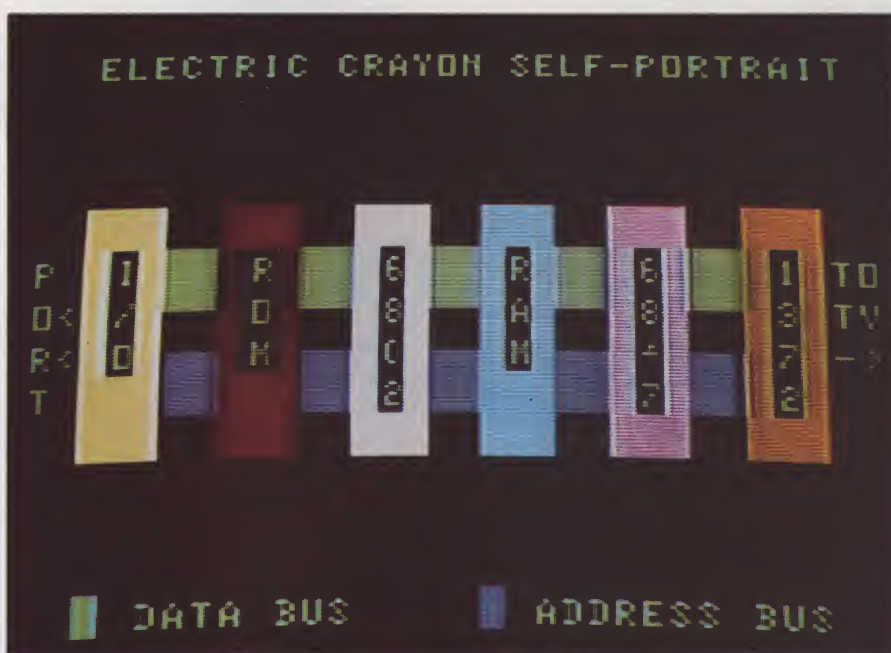
3.579545 MHz crystal controls an internal clock; an output on the MC1372 supplies a clock signal to the VDG and the rest of the circuit.

The brain behind the whole operation is the 6802 microprocessor chip, which is basically an enhanced 6800. In addition to the features of the 6800, the 6802 includes a built-in 128-byte random access memory, which is used as a scratchpad memory by the Electric Crayon's software. The 6802 is kept busy executing the graphics software, placing picture information in the display memory, feeding control signals to the VDG and directing traffic on the address and data buses.

Memory in the Electric Crayon consists of 1024 bytes of display random access memory (RAM) and 1K of read-only memory (ROM) containing the operating system (dubbed EGOS by Percom), with sockets for adding an additional 5K of display memory, 1K of ROM and 1K of program RAM. All RAM chips are 2114s; two of these are required for each 1K of memory. The 1K of display memory furnished will support the alphanumeric display mode and graphics modes of up to 128×64 picture elements. More memory may be added to support the denser graphics modes (refer to the section on display modes for a discussion of memory requirements).

The graphics software that controls the unit is contained in one 2708 erasable read-only memory (EROM) with a capacity of 1K, and a socket is present for a second 2708 to expand the software. Sockets are also provided for two more 2114 RAM chips, which can be used to contain programs loaded in by the user. These are not, however, at all essential for normal operation.

The display memory is loaded by the 6802 in response to commands entered via the input device. This memory stores control information for each picture element of the display, with each location in memory corresponding to a location on the screen. Depending on the mode selected, each picture element displayed requires from one to eight bits of memory. The VDG scans the display memory and produces a video signal based on its contents. Properly coded display data can also be loaded directly into the display memory from the input device, using the LD* (Load) command of the operating system.



Electric Crayon self-portrait.

Input to the Electric Crayon is through a 6820 peripheral interface adapter (PIA) containing dual I/O ports. One of these ports is monitored by the control program, EGOS, for input commands coming from an attached keyboard or computer. The other half of the 6820 can be hooked up by installing jumpers from points on the printed circuit board to the desired contacts on the rear panel connector. Also, a second 6820 can be plugged in, providing two more ports via a separate connector. However, you must load in your own program to access any port other than the normal input port.

Power is furnished by a regulated supply with dc outputs of 12 V, -5 V and +5 V. A small step-down transformer mounted to the bottom of the cabinet provides isolation from the ac power line.

Display Modes

The Electric Crayon has ten display modes providing alphanumerics, semigraphics and graphics in up to eight colors (green, yellow, blue, red, buff, cyan, magenta and orange) plus black.

Mode 0—alphanumerics/semigraphics. This mode is divided into two subsets, which can appear on the screen simultaneously. The first, alphanumerics, will display any of 64 uppercase letters, numbers and various symbols, punctuation marks and math operators in an 8×12 dot pat-

tern. Colors can be green or orange on a black background, or black on a green or orange background.

The second subset, semigraphics, is a bit more complicated. Each semigraphics display element consists of a rectangular block, with 32 blocks fitting horizontally across the screen and 16 vertically; this gives a total of 512 blocks per screen. In mode 0, each of these blocks is divided into four segments, as shown in Fig. 1a. Within each block, these segments can either be illuminated or extinguished, giving 16 possible patterns in any one of the eight colors (segment selection is described under the commands section of this article). These blocks with appropriate patterns illuminated can be combined to make low-resolution pictures, block letters and so on.

Incidentally, graph paper is helpful in constructing a picture with semigraphics blocks, and screen layout pads for the denser graphics modes are available from Percom.

Mode 1—semigraphics. This mode is similar to the four-segment semigraphics of mode 0, except that each

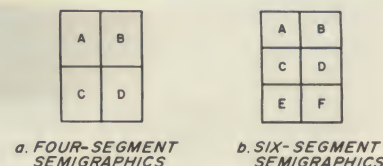
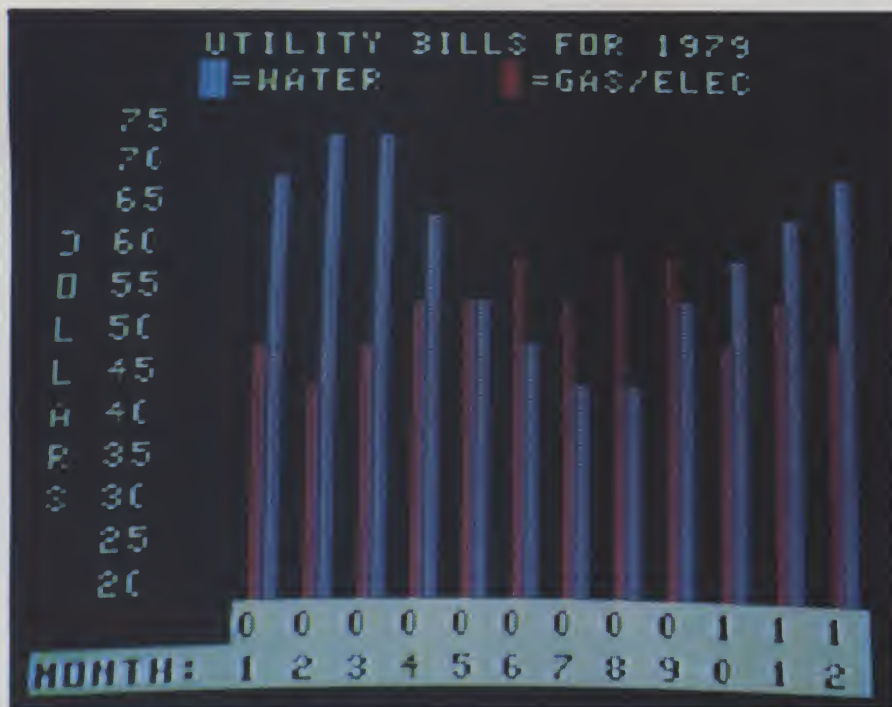


Fig. 1. Semigraphics.



A bar chart in mode 0 semigraphics.

display block is divided into six segments instead of four (see Fig. 1b). Again, there are 32 blocks across the screen and 16 down. The colors can be green, yellow, blue and red on a black background, or, alternately, buff, cyan, magenta and orange on a black background when the Invert command is in effect (refer to the section on commands for details on color selection and inversion procedures).

Mode 2—64×64 graphics. Modes 2 through 9 are full graphics modes, wherein each display element is either on or off, and not subdivided as in the semigraphics modes. Mode 2 provides 64 elements across the screen and 64 down, with each element consisting of four dots horizontally and three screen lines vertically. Colors available in this mode are green, yellow, blue and red on a green background, or buff, cyan, magenta and orange on a buff background in inverse colors. Note that elements displayed in the same color as the background will not be visible, but can be used to erase previously displayed elements of another color to provide animation effects.

Mode 3—128×64 graphics. This mode provides 128 elements across the screen and 64 down. Colors are black and green on a black background surrounded by a green border, or black and buff on black with a buff border. The border is not visible in modes 0 through 2 since it is the

same color as the background.

Note that modes 0 through 3 can be implemented using the 1K of display memory provided with the Electric Crayon. Modes 4 through 9 require additional memory as indicated.

Mode 4—128×64 graphics. This display mode has the same resolution as mode 3, but two pairs of four colors are available as in mode 2. You need 2K of display RAM.

Mode 5—128×96 graphics. With this mode, display resolution improves in the vertical direction; colors are identical to mode 3. Again, 2K of RAM is required.

Mode 6—128×96 graphics. Same resolution as mode 5, but with four colors available as in mode 2. This mode requires 3K of display RAM.

Mode 7—128×192 graphics. Better resolution with the same color choices as mode 3. It requires 3K of display memory.

Mode 8—128×192 graphics. This mode provides the same resolution as mode 7, but with the four colors of mode 2. This mode requires 6K of memory.

0—Green	4—Buff
1—Yellow	5—Cyan
2—Blue	6—Magenta
3—Red	7—Orange

Table 1. Color values for the C command.

Mode 9—256×192 graphics. This is the highest resolution mode, with 256 elements across the screen and 192 down. Each element is one dot wide and one scan line high; colors are the same as in mode 3. It also requires 6K of RAM.

The Electric Crayon Graphics Operation System (EGOS)

EGOS is the Electric Crayon's graphics control program, located in the on-board read-only memory. It accepts and processes commands entered via the main input port; these commands consist of ASCII letters and numbers and may be entered directly from a keyboard attached to the port. A more satisfactory approach is to connect the input port to a parallel output port on your computer and send commands to EGOS using PRINT statements in a BASIC-language program. Some hints on doing this will be offered later. Meanwhile, each command will be explained separately.

ERS—Erase command. As the name implies, this command erases the screen of whatever is displayed, leaving only the background color and border, if it is visible.

M—Mode command. This command selects one of the ten display modes and is normally the first command issued when generating a display. The format is Mx, where x is a number 0–9 corresponding to the desired mode. The Mode command should be followed by ERS to clear the screen; reversing this order could leave garbage on the screen. Also, the M command must be followed by another character, such as a space or carriage return, before it takes effect.

C—Color command. The C command selects the colors to be used when generating a display; the resultant colors depend on the mode selected. The format is Cx, where x is a number from 0 to 7 denoting the desired color (see the color values in Table 1).

For mode 0, the color assignments are exactly as shown in the table. For example, entering C2 will produce blue, and C7 orange; in other words, all eight colors are available. If you select a four-color mode (such as mode 1), the only valid color commands are C0, C1, C2 and C3. If the display is in noninverted mode (see the I command), the colors in the left-hand column of Table 1 will be selected with the above commands (i.e., C0 = green, C2 = blue, etc.); if the

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```

REM          THIS PROGRAM WILL DISPLAY ALL POSSIBLE PATTERNS FOR
REM          MODE 1 SEMIGRAPHS, IN FOUR DIFFERENT COLORS.
REM
REM          LPRINT "M1 ERS"
REM          Y=0
REM          FOR C=0 TO 3
REM          X=0
REM          LPRINT "C",C
REM          FOR P=0 TO 63
REM          LPRINT "P",P
REM          LPRINT "S ",X," ",Y
REM          X=X+1
REM          IF X=32 THEN Y=Y+2
REM          IF X=32 THEN X=0
REM          NEXT P
REM          NEXT C
REM          END
REM          SET MODE & CLEAR SCREEN
REM          INITIAL Y AXIS VALUE
REM          LOOP THRU COLOR VALUES
REM          INITIAL X AXIS VALUE
REM          SET COLOR
REM          LOOP THRU PATTERN VALUES
REM          SET PATTERN VALUE
REM          PLOT THE POINT
REM          INCREMENT X AXIS VALUE
REM          IF END OF LINE, GO DOWN
REM          2 LINES & RESET X AXIS
REM          GET NEXT PATTERN VALUE
REM          END OF PATTERNS, DO NEXT COLOR

```

Listing 1. A BASIC program to display all patterns for mode 1 semigraphics.

display is inverted, the colors from the right-hand column will be active (C0=buff, C1=cyan, etc.).

Similarly, in modes having only two colors, the only valid color commands are C0 and C1, with C0 producing black (the same as the background) and C1 producing either green or buff for noninverted or inverted displays, respectively. The C command should be issued after the display mode is selected, and will stay in effect until another C command is issued.

Colors can be changed for each element in the display while in the four- or eight-color modes, but all elements in the two-color modes must be the same color. In other words, the entire display must be green on black or buff on black, not a combination of the two. I found the section on color selection in the Electric Crayon manual rather confusing, so I hope this discussion has clarified the subject.

I—Invert command. The I command will change the displayed colors to their complementary colors as explained under the C command; it has no effect in mode 0, which can display all eight colors simultaneously, except to change the color of characters produced with the A or R commands from green to orange. In other modes, this command will invert all colors on the screen, which is to say you cannot use one set of colors on part of the screen and their complements on another. However, interesting blinking effects can be obtained by creating a display and then issuing periodic I commands to reverse the colors.

P—Pattern command. This command operates only in the two semigraphics modes and determines which segments of each display block

are illuminated. The command is entered as Pn, where n is the code for the particular pattern desired. There are 16 possible combinations for mode 0, with four segments per display block, and 64 for mode 1, with six segments. Space does not permit describing every possible combination, but in both modes 0 and 1, P0 means that all segments will be extinguished, and P15 and P63 mean that all are illuminated for the two modes, respectively.

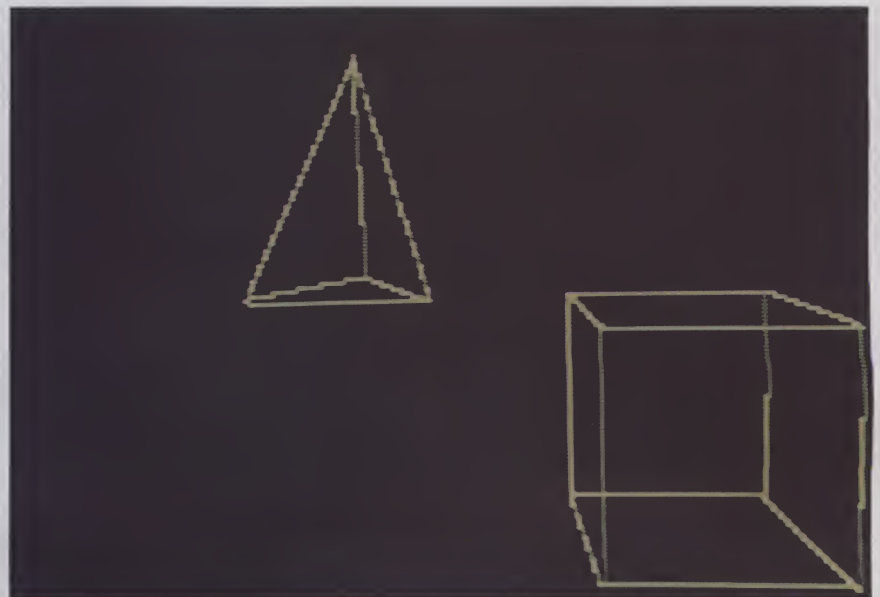
The easiest way to discover the effects of various values for Pn is to write a simple BASIC program to increment through all possible values and output appropriate commands to the Electric Crayon that will display the results. Listing 1 shows such a program.

A—Alpha command. The Alpha

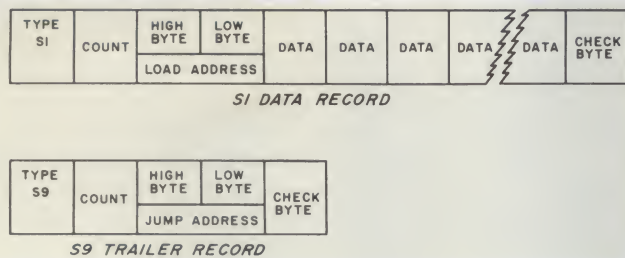
command displays strings of characters in designated locations on the display screen. This command is valid only for mode 0 and can be used in combination with mode 0 semigraphics. The format is A x y aaa..., where x and y are the desired horizontal and vertical screen coordinates and aaa... is the string of characters to be displayed. For example, the command A 5 8 GRAPHICS will display the word "GRAPHICS" starting at the sixth column of the ninth display line. Valid values of x are 0-31, and 0-15 for y. If the character string is too long to fit on one line, it will be continued on the following line; the command terminates when a carriage return is received. The characters will appear as green on black or orange on black, depending on whether the Invert command is in effect.

R—Reverse Alpha command. This command is identical to the A command, except that the characters appear as black on a green or orange background.

S—Set command. The Set command is used to illuminate a single display element on the screen by specifying the desired x and y coordinates in the format S x y; the valid ranges for x and y vary according to the mode being used, and range from 0 to the maximum number of display elements for that mode in the x or y direction minus 1. When using either of the semigraphics modes, a P command must be issued before the S command to turn on the desired seg-



A 3-D picture in mode 9 using the Sublogic graphics package.



EACH BLOCK REPRESENTS ONE BYTE
HEXADecimal OR TWO ASCII CHARACTERS

Fig. 2. Motorola S1-S9 record format.

ments of the display element. The resulting value of P will remain in effect for all subsequent S commands until another P command is issued. A C command will determine the color displayed by S commands that follow.

H—Horizontal Line command. Using the format H x y l, the H command will display a horizontal line starting at the specified x and y coordinates for a length of l. The maximum values of x, y and l depend on the mode selected with a prior M command, but any value above the allowable limit will be automatically truncated to the maximum. As with the S command, a P command should be issued first to set the desired element pattern when in the semigraphics modes.

V—Vertical Line command. Same as the H command, except that it displays a vertical line using the command format of V x y l.

LD*—Load command. This command can be used to load machine-language programs into the optional program RAM to provide additional software routines, and can also load properly encoded display data directly into the display memory, causing it to appear on the screen. For example, instead of using the Color and Set commands to illuminate points on the screen, you could load a bit pattern for the desired color into the display memory address corresponding to a specific screen location.

Data entered with the LD* command must be in Motorola S1-S9 ASCII-hexadecimal format, as shown in Fig. 2. All fields in the S1 and S9 records are in ASCII-hexadecimal format, meaning that two ASCII characters are used to represent one byte in hexadecimal notation (i.e., a one-byte field containing F6 in hex would be entered via the input device as F and 6, thereby allowing hexadecimal data to be entered on an ordi-

nary ASCII keyboard). After the LD* command is entered, the Electric Crayon will read S1 and S9 records from the keyboard or computer into memory, and then either begin executing the program that was entered or return to EGOS and wait for more commands.

Data to be entered must be in the S1-S9 record format, wherein each record consists of a type code (S1 or S9), a count field, an address field, a checksum and, in the case of S1 records, a variable-length data field. The first field in a record must be either S1 for a data record or S9 for a trailer record, and the second must be a count field containing the total number of hex bytes in the address field (2), the data (variable) and itself (1). The third field is a two-byte address field, indicating the load address for the following data if in an S1 record, or an address where the Electric Crayon should begin execution if in an S9 record. If an S9 record contains an address field of all zeros, control will return to EGOS. The fourth field in an S1 record contains the data to be loaded; all of the data does not have to be contained in one record, but may be continued in several S1 records. The number of data bytes per record is arbitrary. The final field is the checksum byte, which is used for detecting errors during loading. It contains the complement of the eight-bit sum obtained when all of the data bytes, address bytes and count bytes are added together, with any carries out of the high-order position ignored.

As the records are read into the Electric Crayon, EGOS totals up its own checksum and adds it to the checksum in the input record. If there are no loading errors, the sum should be zero, since the checksum in the record was complemented prior to being output. If an error does occur, EGOS will print "LOAD ER-

ROR" on the display screen and await more commands. Loading stops when an S9 trailer record is read, and control passes to the address in the record or to EGOS if that address is zero.

Hardware Interfacing

If you want to connect the Electric Crayon to a Radio Shack TRS-80 computer, interfacing is a snap; although no connection cable is included with the Electric Crayon, two different cables for the TRS-80 are available from Percom. Both cables let you connect the unit to a TRS-80 in place of a printer, with one cable plugging into a TRS-80 expansion interface and the other connecting to the TRS-80 printer interface cable. In either case, the LPRINT command in BASIC is used to send commands to the Electric Crayon via the printer port. The procedure is thoroughly explained in the manual supplied with the Electric Crayon.

Connecting the unit to a parallel output port on another type of computer is a bit more involved, but still not too difficult. You must first become familiar with the pin assignments for channel A of the Crayon's computer port (Appendix A1 in the Electric Crayon manual). The signals at this port are the eight data lines, D0 through D7, which accept data from the external computer, and two control lines labeled STROBE and BUSY.

The first, STROBE, is an input signal sent from the external device's output port indicating that valid data is present on the data lines. Most popular I/O boards for various computers have this signal present on each parallel output port; this signal must be negative true; that is, it goes low to indicate data present.

The second line, BUSY, is an output signal from the Electric Crayon to indicate that it cannot accept input data and that the computer should wait until the line goes low before sending anything. This signal should be connected to one data line of an input port that is used as a status port by the computer; again, most I/O boards include a status port. If your computer's parallel output port has an acknowledge input for accepting a handshaking signal from the external device, it should be enabled by tying it to +5 V dc. A simple program that waits to transmit data to the Crayon until the BUSY line is low is shown in Listing 2, written in 8080 assembly language.



Mode 9 graphics—a Lissajous figure plotted with a BASIC program.

Although the manual gives pin numbers on the rear panel connector for each signal, it makes no mention of how the pins are located on the connector. Viewed from the rear of the chassis, the computer port connector is on the right, with the auxiliary port connector on the left. The computer port connector is a card-edge type having 17 pins on each side, with pin 1 being the leftmost pin on the underside of the board. Pin 2 is above pin 1 on the top of the board; thus, all odd-numbered pins are on the bottom and even-numbered pins on top.

A suitable connector is the AP Products 924064-36-R, which comes attached to 18 inches of ribbon cable and is available from most large mail-order parts outlets. Any similar connector with 0.100-inch pin spacing should also work. The auxiliary port requires a 40-pin card-edge connector, also with 0.100-inch spacing. Pins 31, 32 and 33 on the computer port connector are grounded, and one of these should be connected to a ground on the computer.

Alternately, a bare-bones graphics system can be set up by attaching an ASCII keyboard to the Electric Crayon computer port. Simply attach each of the data lines from the keyboard to the corresponding line on the port and connect the keyboard STROBE output to the STROBE input on the

port. You can then type commands to the Electric Crayon on the keyboard. While this method is not as elegant as attaching a computer, it is a good start.

Video Connections

If you have a video monitor, connection to the Electric Crayon requires only an F59 connector, a length of RG-59/U coax cable and a connector to fit the video input on the monitor. Instructions are furnished for converting the Electric Crayon to output a UHF signal so that it can be connected to the antenna terminals of a TV set, but this requires cutting components from the circuit board and would be difficult to reverse.

Instead, I recommend using an inexpensive rf modulator such as the Pixie-verter by ATV Research, which connects between the video output on the Electric Crayon and the anten-

na terminals on the TV set. This lets you use either a TV set or a monitor, the latter producing higher resolution with the denser graphics modes. A monitor also will eliminate interference caused by stray signals from the computer that tend to sneak in through the antenna terminals and garble the picture.

If you do use a modulator, be sure to disconnect the antenna from the TV set to prevent broadcasting your signal to other nearby sets; you might think computer graphics are fascinating, but your neighbors may not share your enthusiasm!

Software Interfacing

If you have a TRS-80 and have connected the Electric Crayon to its printer port according to the instructions in the manual, all that you have to do to talk to the Crayon is use the LPRINT BASIC statement to send commands to the printer port. For example, the statement LPRINT "ERS" would erase the display screen.

If your computer is not a TRS-80, things get a little stickier. The easiest approach is to use a version of BASIC that includes an LPRINT statement and then connect the Electric Crayon to the printer port. This approach is a bit inconvenient, however, if you have a printer and must switch devices whenever something needs to be printed.

A more elegant approach is possible if your BASIC includes a POKE statement and you know where the I/O driver routines are located in memory. Connect the Crayon to a separate port, then include a BASIC subroutine in your program to POKE the Electric Crayon port numbers and status port mask bits into the I/O driver routine for the printer, so that output from the LPRINT statement goes to the Crayon port instead of the printer. A similar subroutine would POKE the original values back in to access the printer (see Listing 3 for an example of this method).

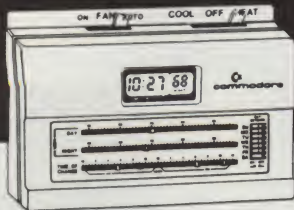
```

*      THIS ROUTINE IS CALLED WITH THE CHARACTER TO BE SENT
*      TO THE ELECTRIC CRAYON IN REGISTER B.
*
*
SEND:  IN      05      ;READ CRAYON STATUS PORT
        ANI     80H     ;IS THE CRAYON BUSY?
        JNZ     SEND    ;YES, WAIT
        MOV     A,B     ;GET CHAR. TO BE SENT
        OUT     08      ;SEND IT TO CRAYON
        RET          ;RETURN TO CALLER
1000 DB05
1002 E680
1004 C20010
1007 78
1008 D308
100A C9

```

Listing 2. Routine that waits for the Crayon's busy line to go low before sending a character.

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```

*          THIS ROUTINE IS CALLED WITH THE CHARACTER
*          TO BE PRINTED IN REGISTER C
*
*
*
LIST:  IN      03      ;READ STATUS PORT
       ANI      01      ;CHECK STAT FOR READY TO PRINT
       JZ       LIST    ;NOT READY, WAIT
       MOV      A,C      ;GET CHARACTER
       OUT      02      ;OUTPUT IT TO PRINTER PORT
       RET                      ;RETURN TO CALLER

```

A. The Standard CP/M Line Printer Routine

```

REM      THIS ROUTINE MODIFIES THE CP/M LINE PRINTER
REM      OUTPUT ROUTINE TO ROUTE OUTPUT FROM LPRINT
REM      STATEMENTS IN CBASIC TO THE ELECTRIC CRAYON
REM
POKE     7E37H,05H      REM CRAYON STATUS PORT
POKE     7E39H,80H      REM CRAYON STATUS BIT MASK
POKE     7E3AH,0C2H     REM INVERT JMP INSTRUCTION
POKE     7E3FH,08H      REM CRAYON OUTPUT PORT

```

B. The BASIC Statements Needed To Modify The Routine

```

*          THIS ROUTINE IS CALLED WITH THE CHARACTER
*          TO BE SENT TO THE CRAYON IN REGISTER C
*
*
*
LIST:  IN      05      ;READ ELECTRIC CRAYON STATUS PORT
       ANI      80H     ;IS THE CRAYON BUSY?
       JNZ      LIST    ;YES, WAIT
       MOV      A,C      ;GET CHARACTER
       OUT      08      ;OUTPUT IT TO CRAYON
       RET                      ;RETURN TO CALLER

```

C. Source Listing Of The Result

Listing 3. Using the POKE statement in BASIC to modify the line printer driver.

If your BASIC has POKE but no LPRINT statement, use the above scheme to modify the console output routine so that output from the PRINT statement will be sent to the Electric Crayon. A similar approach can be applied to other languages, such as FORTRAN. Of course, commands can be sent to the Crayon from assembly-language programs, but numeric values (such as x-y coordinates) must be converted to ASCII character strings for transmission to the unit. For versatility and easy implementation, BASIC is the way to go.

Observations

Having used the Electric Crayon for several weeks with a variety of applications, my experiences thus far have been quite favorable. I phoned my order directly to Percom (they accept credit cards), and received the unit in about five weeks.

After reading the manual and connecting the Crayon to my monitor, I threw the power switch and rejoiced as the sign-on message flashed on the screen. I then spent several hours connecting the unit to a parallel port

on my computer, a souped-up Altair 8800, and writing some simple software driver routines.

As I mentioned, the manual is a bit vague concerning interfacing to anything other than a TRS-80, so some trial and error was necessary. The manual does contain a good section on familiarization with the EGOS commands and includes some simple demonstration programs. I have had good results driving the Electric Crayon with programs written in CBASIC using the CP/M operating system, by poking modifications into the CP/M printer output routine as shown in Listing 3. The Crayon's semigraphics modes are ideal for drawing colorful bar charts and graphs using values calculated with BASIC programs, while mode 9 is great for plotting equations. I have also had excellent results driving the Electric Crayon with the BASIC language 3D graphics package from Sublogic. The package is well-documented and, coupled with the Crayon, is a very good tool for learning computer graphics concepts.

I found fault with only two aspects of the Electric Crayon's performance.

The first is that the ERS command flashes garbage on the screen for an instant before erasing the display. This is only a minor annoyance unless you want to erase the screen between frames of an animated display. The second is that the time required to draw lines using the H and V commands in the denser graphics modes is rather high; several seconds are required to draw long lines in mode 9, which is bad news for animated displays.

One solution is to load the display data directly into the Electric Crayon's display memory with the LD* command, producing an almost instantaneous result. The catch is that you have to write some rather complex assembly language routines to calculate load addresses, data content and checksum, and convert everything to ASCII-hexadecimal format for transmission to the Electric Crayon.

Conclusion

To sum up, I am generally pleased with the Electric Crayon; it's a good buy for the money. The documentation is well-written and, with the aforementioned exceptions, complete and helpful. The schematic diagram and theory of operation provided help unravel the mysteries of the Crayon's innards, and the source listing of EGOS is invaluable for the software hackers. The unit is powerful enough to be a stand-alone graphics computer with its four I/O ports and provision for adding program and read-only memory. With a little imagination, the possibilities are almost endless. Happy coloring! ■

Additional Resources

- A 3D Microcomputer Graphics software package written in BASIC as well as various assembler languages is available from Sublogic, Box V, Savoy, IL 61874. The cost is quite low and the extensive documentation does a good job of explaining the basics of computer graphics.

- The Pixie-verter from ATV Research, 13-B Broadway, Dakota City, NE 68731, is a good rf modulator for use with the Electric Crayon. It costs about \$10 and is available from many dealers.

- The TV Typewriter Cookbook by Don Lancaster, published by Howard Sams, contains detailed instructions on adding a direct video input to an ordinary TV set.

Using the LD* Command

This example explains the S1 and S9 records required to draw a line on the display screen by loading picture data directly into the Electric Crayon's display memory. Specifically, a blue line eight blocks long will be drawn across the top of the screen using mode 1 semigraphics. Under mode 1, one byte of display memory is needed for each display block on the screen, since both color and semigraphics pattern information must be present. This data is encoded in each mode 1 display byte as follows:

$C_1 C_0 P_5 P_4 P_3 P_2 P_1 P_0$

where C_1 and C_0 select the color, and P_5-P_0 select which of the six segments of each semigraphics block are illuminated. This information is contained in the Motorola applications notes for the MC6847, available from Motorola distributors.

In this example, we will select blue with all segments illuminated, which is encoded like this:

1 0 1 1 1 1 1 1

Therefore, each of our bytes in display memory will contain 10111111 in binary, or BF in hexadecimal.

We want to draw our line across the top of the screen starting at the leftmost position for a length of eight display blocks, which will require eight bytes in the Crayon's display memory. According to the Electric Crayon manual, the display memory starts at address

D000 in hex, beginning in the upper left-hand corner of the display. Since there are 512 block positions on the screen in mode 1, and each block requires one byte of memory, the last position on the screen is at address D1FF. This block is in the lower right-hand corner of the screen. Our eight-block line will use addresses D000 through D007.

We can now begin building our S1 data record. The first two bytes are the record type, S1. The second two are the count field, containing the number of *hex* bytes encoded in the count, address and data fields. In our example there are eight data bytes, plus two bytes for the address field and one for the count field itself. Thus, we have $8 + 2 + 1 = 11$, or 0B in hex. After converting to ASCII, the characters 0 and B are placed in this field. The next field in the record is the load address, which in this case is D000; the four ASCII characters D000 are inserted here. The eight data bytes are next, again expressed in ASCII as B and F repeated eight times, for a length of 16 bytes.

Now for the hard part: the checksum. It is calculated by adding together the data bytes, address bytes and count byte as an eight-bit sum, with carries out of the high-order bit ignored; the total is then complemented by making each zero bit 1 and each one bit 0, converted to two ASCII characters and placed in the record. Note that the hexadecimal values for the fields are added together before they are converted to ASCII characters.

In our example, we will add the count byte (0B), the address bytes (D000) and the eight data bytes as follows:

$0B + D0 + 00 + BF + BF + BF + BF + BF + BF + BF + BF$

giving a total of D3 if high-order carries are dropped. The complement of D3 is calculated to be 2C by inverting each bit. This value is converted to ASCII 2 and C and placed in the record. The checksum is most easily calculated using an assembler language routine that zeros an eight-bit accumulator, adds each byte to it, and then takes the complement (the 8080 assembler language instruction to do this is CMA, with the Z-80 equivalent being CPL). The complete ASCII S1 record appears as follows, with a length of 26 bytes: S10BD000BFBFBFBFBFBFBFBF2C

The same rationale is used to construct the count, address and checksum for the S9 trailer record; the zero address field returns control to EGOS after the record is read. The S9 record appears below:

S9030000FC

The commands that need to be entered to draw our line are as follows:

M1 (Set Mode 1)

ERS (Clear Screen)

LD* (Load)

S10BD000BFBFBFBFBFBFBFBF2C

S9030000FC

Although this method is much more cumbersome than using EGOS commands to draw displays, it is faster and is ideally suited to assembler language driver programs.

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Dots Incredible!

By James J. Conroy

"You, sir!—define a character!" For the computerist who is lucky enough to have a dot-matrix printer, this command may just be the key to hard copy that ranges from graphics to foreign language scripts.

The dot-matrix printer system arrived on the scene some years ago and brought a new dimension to hard copy: user-defined character (UDC) sets.

Unlike a fixed-type element printer (such as a typewriter with type bars or a type ball), the dot-matrix mechanism uses a single moving print head with an array of holes, through which solenoid driven wires can protrude. By intelligent selection of the impact of these wires, the entire American Standard Code for Information Interchange (ASCII) character set is produced. Typically, the matrix of the print head has a dimension of 5 by 7 or 7 by 9. This means that the print head has one bank of seven wires that prints five columns to form a character (or for the 7 by 9 matrix, nine wires and seven columns). The permutations—or possible combinations—of dot configurations that could conceivably be produced are described in Table 1.

That's a lot of possible characters, and, for the most part, we are only using a subset of 96 characters—the ASCII set! So what about all the rest of the character configurations? Well, some printer manufacturers have opened the door to using the whole matrix by letting the programmer ac-

cess and control the print head.

How It Is Done

The manner in which a programmer is empowered to produce user-defined characters can vary from one machine to the next. For our purposes, we will consider the methodology set forth for the new Base 2 printer. This compact and versatile unit is one of the most pleasing combinations of low cost and high performance I have seen. In addition to the options available to enhance the performance of this little marvel, the UDC feature comes as a standard item. (As do the full upper/lower ASCII set, elongated characters, immediate interface capability for the four most popular interface modes

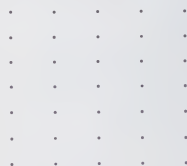


Fig. 1. A wire can impact and produce a dot in any or all of the positions.



Fig. 2. This design produces a "plus or minus."

$$5 \times 7 = 35 \text{ dots (on or off)} = 2 \text{ to } 35\text{th power} = 3.43597 \times 10^{10}$$
$$7 \times 9 = 63 \text{ dots (on or off)} = 2 \text{ to } 63\text{rd power} = 9.22339 \times 10^{18}$$

Table 1.

and a host of other desirable features.)

As with most other dot-matrix printers, the Base 2 uses resident software (usually referred to as firmware) to define and control the print head's configuration of the print characters. In fact, provisions are included in its design for the easy installation (via IC sockets) of additional EPROM chips to boost the number of on-board character sets to anywhere from four to eight sets. Base 2, Inc. (1835A Dawns Way, Fullerton, CA 92631), currently offers four sets in EPROM and plans for more.

To create and use your own character set, the following steps must be taken:

- Design and define the characters you want to produce. The result is a series of data statements which must be transmitted to the printer.
- Transmit the data to an allocated memory in the printer (RAM).
- Switch to your user-defined characters (when required) by a special control code.
- Switch back to standard characters (by control code) as necessary.

Let's go into a little more detail for each step to see how easy it is.

Design and Define

It was a pleasant surprise to find out how simple it is to design a character for the Base 2 printer. Begin by envisioning the print matrix configuration. Basically, it looks like Fig. 1. Each dot represents a position where a wire can strike to produce an impression. Therefore, you must decide which pattern of impressions will create an image of your desired char-

Address correspondence to James J. Conroy, 57 E. Garrison St., Bethlehem, PA 18018.


```

35 REM THIS SETS PRINTER UP FOR FEEDING DATA
40 LPRINT CHR$(27);CHR$(75)
45 REM THIS READS AND FEEDS DATA
50 FOR C=1 TO 48
60 FOR A=1 TO 10
70 READ X
75 X=X+128
80 LPRINT CHR$(X);
90 NEXT A
100 RESTORE
110 NEXT C
115 REM THIS TESTS STANDARD CHARACTERS
120 LPRINT"ABCDEFGH IJ"
130 LPRINTT CHR$(27);CHR$(76)
135 REM THIS TESTS UDC
160 LPRINT "ABCDEFGH IJ"
500 DATA 0,0,0,0,0,68,68,127,68,68

```

Listing 1.

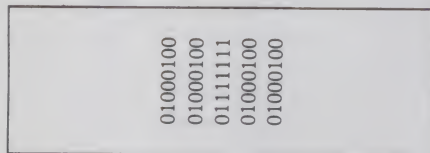


Fig. 3. Ones now represent dots, and zeros represent spaces.

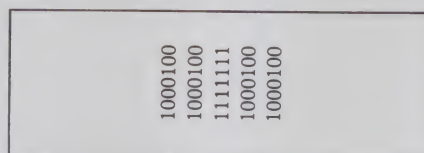


Fig. 4. An extra zero has been added at the bottom of each column to make eight-bit binary numbers.

acter.

For example, consider the design of the non-ASCII character for the mathematical term "plus or minus." In Fig. 2, the appropriate dots have been marked to produce this symbol. To encode this into a data statement that will define this symbol for the printer to store in its memory, you can imagine the same design with zeros for blank spaces and ones for dots. (See Fig. 3.)

Does this remind you of anything? What we have now are five columns that represent binary numbers! This is the key to forming the necessary data statement to define this character. It will be convenient to consider each column as an expression of an eight-bit binary number. Bit number 8 will always be zero (imagine one more zero under each column). If you turn Fig. 4 90 degrees clockwise, you can easily see the binary numbers which define this character. Since the Base 2 printer has built-in provisions for one-dot intercharacter spacing, you need only concern yourself with the construction of the character itself.

To actually write the data statement, you must consider the decimal

equivalent of these five binary numbers. It turns out that for this design, you really only have two different numbers. They are

01000100 = 68

01111111 = 127

Therefore, the data statement should read:

```
500 DATA 68,68,127,68,68
```

This will define your single character.

Transmit

You are now ready to transfer the information in the data statement to the printer. The printer will store the data in its RAM, which is set aside for this purpose. To transmit the character definitions (or, for that matter, any information or command) to the Base 2, employ the LPRINT CHR\$(X) command from BASIC. In my talks with the Base 2 people (who were quite helpful and courteous), I learned that the BASIC software control codes may vary from one computer to the next. What I am relating are the commands for a Base 2/TRS-80 interfacing. The general idea is the same for other Base 2/computer interfaces.

You must always advise the Base 2

printer that a command or information is being sent. The command code for this is LPRINT CHR\$(27). This must *always precede* any instruction which you are going to send. The next command—LPRINT CHR\$(75)—is the code that tells the Base 2 that you are about to load data into the UDC/RAM. These two commands would be expressed in the BASIC statement as:

```
40 LPRINT CHR$(27);CHR$(75)
```

Now you want to transmit the character defining data, so you must READ the data statement and LPRINT the data values in CHR\$(X) form. A sample program might be:

```

50 For A=1 TO 5
60 READ X
70 LPRINT CHR$(X)
80 NEXT A
500 DATA 68,68,127,68,68

```

You are almost there. You must take into consideration one more factor. When implementing the UDC feature of the Base 2 printer, you cannot just send five elements of data down the line to the printer memory. You must fill up the entire UDC/RAM, even if you don't have that many characters to define. There is space in the memory for 96 characters (at five data elements per character), so you must send 480 elements of data to the printer. The logical choice is to fill the remaining area in the memory with data that defines the "space" character. In our situation, it might be nice to have spaces in between our "plus or minus" character (for test purposes), so you can change the data statement to read:

```
500 DATA 68,68,127,68,68,0,0,0,0,0
```

This defines your designated character and a "space." You should further modify the program to transmit this data (for two characters) 48 times. Remember: 48×2 characters (five data elements each) = 96 characters (480 elements of data). The program now reads:

```

40 LPRINT CHR$(27);CHR$(75)
50 REM WE HAVE TO FILL UDC/RAM
  WITH 96 CHARACTERS
60 FOR C = 1 TO 48
70 REM WE NOW HAVE 10 DATA ELE-
  MENTS
80 FOR A = 1 TO 10
90 READ X
100 LPRINT CHR$(X)
105 NEXT A
110 RESTORE
115 NEXT C
500 DATA 68,68,127,68,68,0,0,0,0,0

```

Use It!

You have designed, defined and

ABCDEFGHIJ
± ± ± ± ±

Fig. 5. The final printout.

stored your very own character. Now use it! To do this, you send the command to the printer which enables the UDC set. (Remember, you have a whole set of these buggers!) It is:
LPRINT CHR\$(27);CHR\$(76)

Previous to this command, you are drawing standard characters from the printer's ROM. Now you will be drawing from the UDC/RAM. A good way to see the difference would be to add the following statements to your program:

```
120 LPRINT "ABCDEFGHIJ"
130 REM ENABLE UDC SET
140 LPRINT CHR$(27);CHR$(76)
150 REM THIS SHOULD GIVE US OUR
    "PLUS OR MINUS"
160 LPRINT "ABCDEFGHIJ"
```

Fig. 5 is the printout from the Base 2, displaying our pride and joy. When defining a whole set of different characters, you might, at this point, have to go back and rework your designs. A little trial and error, along with visual comparisons, will finally yield a pleasing end product.

Listing 1 is the program which accomplishes our goal.

Switch

Now you have the character(s) and you can call the UDC set when you need it. Don't forget to switch back to the standard ASCII set for your other output. This is accomplished by the command:

```
LPRINT CHR$(27);CHR$(77)
```

If you remember your switching commands, you can merrily bounce back and forth from standard to UDC to your heart's content. Yes, Virginia, there is even a command to wipe out your creation from the RAM:

```
LPRINT CHR$(27);CHR$(74)
```

Conclusion

By now, visions of possibilities must be popping into your head. What can you define? Almost anything. I'm working on an astrological character set. Next, I'll probably create a UDC set that matches the graphics blocks of the TRS-80 video display. If you come up with something worthwhile, you might want to send a copy to Base 2, Inc. They can even burn an EPROM that will give you your set in a permanent mode. ■

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Database Manager For the North Star

By John E. Bailey

I've seen a number of database systems described or advertised in different magazines. In each case, I wondered if the system would do what I wanted it to do, or if I would

have to pay a premium price for the few simple functions I was looking for.

To avoid such an unpleasant situation, I decided to write my own.

I took several factors into consideration when designing my system. I didn't want a database that had to have records with unique keys. I also didn't want to be concerned with keeping the records on the database in any particular sequence. To do this, I had to sacrifice access time, since each database request involves a sequential search. But most of the databases I work with are relatively small, so I can live with this longer access time.

I also wanted a system where I could access any number of different databases with one program. I wanted to be able to add records, delete records, update records, search for records by key, scan for records containing a given character string and retrieve records by record number.

All of these considerations led to the development of the database manager system for the North Star described here.

Defining the Database

First, I'll define a hypothetical database to use as an example. Suppose I want a catalog of all the spare parts in my parts box: resistors, capacitors, transistors, integrated circuits and so on. I want each record in the catalog to contain the part number, a description of the part and how many I have on hand.

The part number will be ten characters long. The first two characters of the part number will be type indicator—IC for integrated circuit, TR for transistor, RS for resistor, CP for capacitor and so forth. The other one to eight characters will be the actual part identifier. Thus, the part num-

```
10 REM ***** DATABASE DEFINITION *****
20 REM
30 REM CODED BY JOHN E. BAILEY
40 REM SULPHUR, LA APRIL, 1980
50 REM
60 REM ***** PROGRAM NAME IS "DBDEFN" *****
70 REM
80 P1=11
90 FOR I=1 TO P1:NEXT
100 DIM L$(15)
110 ! " ***** DATABASE DEFINITION *****
120 !
130 INPUT " ENTER NAME OF DATABASE <4 CHARACTERS> ? ",N$
140 IF LEN(N$)>4 THEN 120
150 F$=N$+"DEFN.2"
160 INPUT " DO YOU WANT ME TO CREATE THE DEFN FILE (Y OR N) ? ",Z$
170 IF Z$<>"Y" THEN 190
180 CREATE F$,4
190 OPEN #1:F$
200 L=0
210 IF Z$="Y" THEN 230
220 READ #1 %0,L
230 INPUT " ENTER TOTAL RECORD LENGTH ? ",R
240 INPUT " ENTER START POSITION OF KEY ? ",K0
250 INPUT " ENTER STOP POSITION OF KEY ? ",K9
260 INPUT " ENTER POSITION OF DELETE FLAG ? ",D9
270 WRITE #1 %0,L,N$,R,K0,K9,D9
280 FOR I=1 TO 11:NEXT
290 ! " BEGIN RECORD DEFINITION PHASE ....."
300 !
310 ! " YOU MAY ENTER UP TO 15 CHARACTERS FOR EACH LABEL."
320 ! " YOU MUST ALSO ENTER THE START AND STOP POSITION"
330 ! " FOR EACH FIELD IN THE RECORD."
340 !
350 I=1
360 L$=""
370 ! " ENTER LABEL ".1." ? ",
380 INPUT " ",L$(1,15)
390 IF L$(1,3)="END" THEN 430
400 ! " ENTER START POSITION FOR ".L$." ? ",
410 INPUT " ",S
420 ! " ENTER STOP POSITION FOR ".L$." ? ",
430 INPUT " ",P
440 WRITE #1,L$,S,P
450 I=I+1
460 !
470 GOTO 360
480 CLOSE #1
490 FOR I=1 TO P1:NEXT
500 INPUT " DO YOU WANT ME TO CREATE THE DATA FILE (Y OR N) ? ",Z$
510 IF Z$<>"Y" THEN 560
520 ! " INPUT " HOW MANY LINES ITEMS IN DATABASE ? ",P
530 D$=N$+"DATA.2"
540 M=INT(R*P/256)+4
550 CREATE D$,M
560 ! " ***** END OF DATABASE DEFINITION PHASE *****
570 !
580 END
```

Listing 1. Database definition program DBDEFN.

John E. Bailey, 1100 Post Oak 1, Sulphur, LA 70663.

bers will look like this: IC7404, RS220K and CP.02MF.

I'll also let the part number be the record key. Each record will contain a 15-character description and two characters to indicate the quantity on hand from 00 to 99. I also need to define a one-character field to be the delete flag. The part number will be in position 1 through 10 of the record, the description in position 11 through 25, the quantity on hand in position 26 and 27 and the delete flag in position 28. The total record length will be 28 characters.

The database consists of two files, one containing the database definition and the other the data. Each database will have a four-character name. For my parts database, the name will be PRTS. The database definition file will be named PRTS-DEFN, and the data file, PRTSDATA. Later you'll see how these names are created by the database programs.

The definition file consists of two sections—the header and the body. The header contains the record number of the next available record, the database name, the record length, the key location and the delete flag location. The definition body contains a variable number of entries. Each entry contains a 15-character label, a start position S and a stop position P. The label names the field that starts in the record at location S and ends at location P. Fig. 1 shows the relationship between the database definition and the database record for the PRTS database.

DBDEFN is the program that creates and maintains the database definition file (Listing 1). P1 is a constant used in each of the programs in the system to define the number of lines on your CRT terminal less 1. The program will ask for a four-character database name, in my case PRTS, which is prefixed to DEFN to form the name of the database defini-

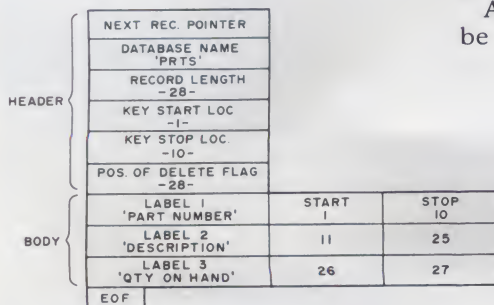


Fig. 1a. Organization of database definition file.

```

***** DATABASE DEFINITION *****

ENTER NAME OF DATABASE (4 CHARACTERS) ? PRTS

DO YOU WANT ME TO CREATE THE DEFN FILE (Y OR N) ? Y

ENTER TOTAL RECORD LENGTH ? 28
ENTER START POSITION OF KEY ? 1
ENTER STOP POSITION OF KEY ? 10
ENTER POSITION OF DELETE FLAG ? 28

BEGIN RECORD DEFINITION PHASE.....

YOU MAY ENTER UP TO 15 CHARACTERS FOR EACH LABEL.
YOU MUST ALSO ENTER THE START AND STOP POSITION
FOR EACH FIELD IN THE RECORD.

ENTER LABEL 1 ? PART NUMBER
ENTER START POSITION FOR PART NUMBER ? 1
ENTER STOP POSITION FOR PART NUMBER ? 10

ENTER LABEL 2 ? DESCRIPTION
ENTER START POSITION FOR DESCRIPTION ? 11
ENTER STOP POSITION FOR DESCRIPTION ? 25

ENTER LABEL 3 ? QTY ON HAND
ENTER START POSITION FOR QTY ON HAND ? 26
ENTER STOP POSITION FOR QTY ON HAND ? 27

ENTER LABEL 4 ? END

DO YOU WANT ME TO CREATE THE DATA FILE (Y OR N) ? Y

HOW MANY LINES IN THE DATABASE ? 150

***** END OF DATABASE DEFINITION PHASE *****

```

Sample run 1. How a database is defined using DBDEFN. The database being defined here is the example PRTS database.

tion file.

If you are running a single disk system, remove the ,2 in line 150. If you are defining a new database, respond Y to line 160. If you want to modify an existing database definition, reply N. Answer each of the questions presented. Type END for the label to end the definition phase. If you want the program to create the data file, respond Y to line 500. The program will create a data file big enough to hold the number of line items you supply in line 520. The name of the data file is the name given in line 130 suffixed by DATA. See Sample 1 for an example of the database definition.

After defining the database, it must be formatted. This is done by

DBFRMT (Listing 2). Entering the name of the database and this program will propagate blanks throughout the entire data file. The actual number of records in the database will be slightly greater than requested in DBDEFN. The next record pointer in the database definition is set to zero. Therefore, this program can be used to reformat an existing database. Normally, though, it would only be run after creating a new database.

Using the Database

After these two steps, the database is ready to use.

First, of course, I load records into the database, using the database

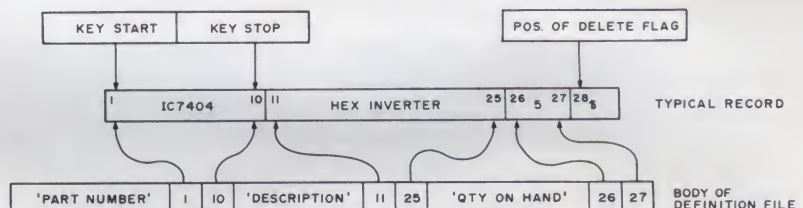


Fig. 1b. Relationship between a record and the database definition file.

manager program DBPROG (Listing 3). It supervises all of the database activities, and is controlled by a menu screen.

Load DBPROG and run it. Type in the database name, and the master

menu will appear. Select option 1 to add records to the database. The program asks for the information by label as the record is defined in the database definition.

At this point you can add as many

records as you want. Remember my previous comments on keys for the example database. If you want to group certain items together, all or the first few characters of the key should be common. For example, all integrated circuits may have a key beginning with IC, resistors beginning with RS and so on. Each time you add a record, the next record pointer in the database definition is incremented by one. Type END at any point to end this phase and return to the menu. Sample 2 shows how records are added to the database.

Records can be added at any time. The location of the next available database record is maintained in the database definition header. If you return via option 1 to add records, the first one will be added at the record that the next record pointer indicates.

Select option 2 to search the database by key. Enter the key you want to search for. You need not enter the entire key. For example, if you enter IC, all records whose keys begin with IC will be retrieved (see Sample run 3). Thus, you can retrieve groups of records with only one access to the database. You can select an alternate key by replying Y to line 740. Enter the starting position in the record of the alternate key. The default key location is reset after each complete access. You may display the entire database by typing ALL for the key.

Records may be routed to the CRT or to the printer. If routed to the CRT, the program pauses after each record is displayed. Press return to continue or type END to stop. If the output is to the printer, there is no pause and the print continues until the end of the database is reached.

You can scan the database for a character string by selecting option 3. Enter the character string you want to scan for. Each record that contains that string will be displayed. The scan process is much slower than the key search and should be used only if a record cannot be retrieved by its key. As before, the program pauses after each record is displayed, and you can type END to stop.

The fastest way to retrieve a record is by record number. You can do this only if you know the physical number of the record you want. Select option 4, enter the record number and it will be retrieved immediately. Record numbers start at 0 and must not be greater than the next record pointer less 1.

```

10 REM ***** FORMAT DATABASE *****
20 REM
30 REM CODED BY JOHN E. BAILEY
40 REM SULPHUR, LA APRIL, 1980
50 REM
60 REM ***** PROGRAM NAME IS "DBFRMT" *****
70 REM
80 P1=11
90 FOR I=1 TO P1:\NEXT
100 !" ***** FORMAT DATABASE *****
110 !
120 INPUT " ENTER NAME OF DATABASE ? ".N$
130 IF LEN(N$)<>4 THEN 110
140 F$=N$+"DEFN,2"
150 OPEN #1.F$
160 READ #1 %0.L.N$.R
170 L=0
180 WRITE #1 %0.L.NOENDMARK
190 CLOSE #1
200 DIM R$(R)
210 R$=""
220 FOR I=1 TO R:R$=R$+" "\NEXT
230 D$=N$+"DATA,2"
240 OPEN #1.D$.L
250 L=INT(256*(L/(R+2))-2)
260 !" THERE ARE".L." RECORDS IN THE DATABASE."
270 !
280 FOR I=1 TO L
290 WRITE #1.R$
300 NEXT
310 CLOSE #1
320 !" ***** FORMATTING OF DATABASE IS COMPLETE *****
330 !\
340 END

```

Listing 2. Database formatting program DBFRMT.

```

***** DATABASE MANAGER *****

SELECT ONE OF THE FOLLOWING OPTIONS:

1 - ADD RECORDS          5 - UPDATE A RECORD
2 - KEY SEARCH           6 - DELETE A RECORD
3 - CHARACTER SCAN       7 - DISPLAY DBDEFN
4 - RECORD NUMBER        8 - SWITCH DATABASES

ENTER YOUR SELECTION ? 1

PARTS NUMBER ? IC7400
DESCRIPTION ? QUAD NAND GATE
QTY ON HAND ? 4

PARTS NUMBER ? IC7402
DESCRIPTION ? QUAD NOR GATE
QTY ON HAND ? 5

PARTS NUMBER ? RS220K
DESCRIPTION ? 220K OHM RES
QTY ON HAND ? 10

PARTS NUMBER ? CP.01MF
DESCRIPTION ? .01 MF CAP
QTY ON HAND ? 2

PARTS NUMBER ? IC7403
DESCRIPTION ? QUAD AND GATE
QTY ON HAND ? 7

PARTS NUMBER ? END

```

Sample run 2. How to add records to the database (option 1). The program will prompt you to supply information as the record is defined in the database definition. Add as many records as wanted. Type END to return to the master menu.

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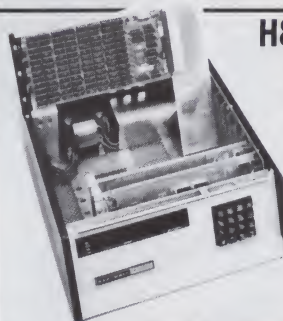
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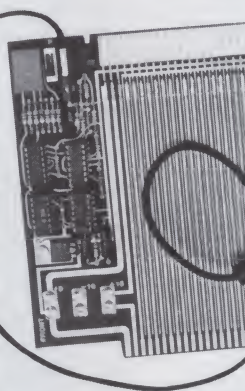
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You can update or delete a database record by selecting option 5 or option 6, respectively. You must know the number of the record you want to update or delete. You can find this by doing a key search or scan. The record will be displayed so that you can verify it. To update a record, simply key in the changes you want to make. Press return to in-

dicate no change. Records are not physically deleted from the database. The location of the delete flag is obtained from the database definition. A # is placed in the delete flag location in the record. This logically deletes the record. A record may be reinstated by using the update mode.

Select option 7 to display the database definition header. Select option

8 to switch to another database.

Other Considerations

DBPROG places certain restrictions on the database. No more than 50 labels are allowed; i.e., the database record must not have more than 50 named fields. This number can be increased by changing the dimensioned sizes of S, P and L\$ in line 80. The maximum key length is 60. This is limited by K\$. The maximum record length is 500, limited by E\$.

DBPROG reads the entire database definition into memory at initialization time. This means that only one physical access is made to this file, even though its individual fields are referenced quite often. The variable L is the next record pointer. Each time a record is added to the data-

Listing 3. Database program DBPROG.

```

10 REM ***** DATABASE MANAGER *****
20 REM
30 REM CODED BY JOHN E. BAILEY
40 REM SULPHUR, LA APRIL, 1980
50 REM
60 REM ***** PROGRAM NAME IS "DBPROG" *****
70 REM
80 DIM S(50),P(50),L$(750),K$(60),A$(15),B$(60),E$(500)
90 P1=11
100 FOR I=1 TO P1:\NEXT
110 !
120 !" ENTER NAME OF DATABASE (4 CHARACTERS) ? ".CHR$(7),
130 INPUT "",N$
140 IF LEN(N$)<>4 THEN STOP
150 F$=N$+"DEFN,2"
160 OPEN #1,F$
170 READ #1,L$,X$,R$,K$,D$
180 I=1
190 IF TYP(1)=0 THEN 280
200 READ #1,A$,X$,Y
210 J=(I-1)*15+1
220 S(I)=X
230 P(I)=Y
240 K=J+14
250 L$(J,K)=A$
260 I=I+1
270 GOTO 190
280 J=(I-1)*15+1
290 L$(J)="END"
300 T=I-1
310 D$=N$+"DATA,2"
320 OPEN #2,D$
330 FOR I=1 TO P1:\NEXT
340 F1=0
350 !" ***** DATABASE MANAGER *****
360 !
370 !" SELECT ONE OF THE FOLLOWING OPTIONS : "
380 !
390 !" 1 - ADD RECORDS 5 - UPDATE A RECORD"
400 !" 2 - KEY SEARCH 6 - DELETE A RECORD"
410 !" 3 - CHARACTER SCAN 7 - DISPLAY DBDEFN"
420 !" 4 - RECORD NUMBER 8 - SWITCH DATABASES"
430 !\
440 INPUT " ENTER YOUR SELECTION ? ".N
450 FOR I=1 TO P1:\NEXT
460 ON N GOTO 510,700,1110,1910,1470,1310,1730,470
470 REM ***** CLOSE FILES AND RETURN TO START *****
480 CLOSE #1
490 CLOSE #2
500 GOTO 100
510 REM ***** ADD RECORDS TO THE DATABASE *****
520 E$=""
530 FOR M=1 TO R\E$=E$+" "\NEXT
540 FOR Q=1 TO T
550 J=(Q-1)*15+1
560 K=J+14
570 S=S(Q)
580 P=P(Q)
590 IF S=D$ THEN 640
600 !L$(J,K)," ? ".
610 INPUT "",B$
620 IF B$="END" THEN 330
630 E$(S,P)=B$
640 NEXT
650 WRITE #2 %L$(R+2),E$,NOENDMARK
660 L=L+1
670 WRITE #1 %0,L,NOENDMARK
680 !
690 GOTO 510
700 REM ***** SEARCH DATABASE BY KEY *****
710 K1=K0
720 INPUT " ENTER SEARCH KEY ? ".K$
730 IF K$="" THEN K$="ALL"
740 INPUT " USE ALTERNATE KEY (Y OR N) ? ".Z$
750 IF Z$<>"Y" THEN 770
760 INPUT ".....ENTER START POSITION OF KEY ? ".K1
770 INPUT " DO YOU WANT A HARDCOPY (Y OR N) ? ".Z$

```

ENTER YOUR SELECTION ? 2

ENTER SEARCH KEY ? IC
USE ALTERNATE KEY (Y OR N) ? N
DO YOU WANT A HARDCOPY (Y OR N) ? Y

REC. 0
PART NUMBER : IC7400
DESCRIPTION : QUAD NAND GATE
QTY ON HAND : 4

REC. 1
PART NUMBER : IC7402
DESCRIPTION : QUAD NOR GATE
QTY ON HAND : 5

REC. 4
PART NUMBER : IC7408
DESCRIPTION : QUAD AND GATE
QTY ON HAND : 7

REC. 5
PART NUMBER : IC7432
DESCRIPTION : QUAD OR GATE
QTY ON HAND : 1

REC. 9
PART NUMBER : IC7475
DESCRIPTION : QUAD LATCH
QTY ON HAND : 2

REC. 10
PART NUMBER : IC74193
DESCRIPTION : SYNC COUNTER
QTY ON HAND : 1

ENTER SEARCH KEY ? IC7432
USE ALTERNATE KEY (Y OR N) ? N
DO YOU WANT A HARDCOPY (Y OR N) ? Y

REC. 5
PART NUMBER : IC7432
DESCRIPTION : QUAD OR GATE
QTY ON HAND : 1

Sample run 3. Two examples of retrieving records by key (option 2). The first example shows how each record whose key begins with IC is retrieved when IC is entered for the key. The second example illustrates a method whereby a single record is retrieved when the full key IC7432 is entered.

More

Listing 3 continued.

```

790 IF Z$="Y" THEN H=1 ELSE H=0
790 FOR I=1 TO P1:NEXT
800 M=LEN(K$)-1
810 M=M+K1
820 F=0
830 READ #2 %F*(R+2),E$
840 IF E$(K1,K1)=" " THEN 930
850 IF K$="ALL" THEN 830
860 IF E$(K1,M)=K$ THEN 880
870 GOTO 910
880 GOSUB 970
890 F1=F1+1
900 IF Z$="END" THEN 330
910 F=F+1
920 GOTO 830
930 IF F1>0 THEN 330
940 ! " ***** NO RECORDS FOUND FOR - ",K$
950 INPUT "",Z$
960 GOTO 330
970 REM ***** PRINT SUBROUTINE *****
980 IF E$(D9,D9)<>" " THEN RETURN
990 !#H,"REC.",F
1000 FOR Q=1 TO T
1010 J=(Q-1)*15+1
1020 K=J+14
1030 S=S(Q)
1040 P=P(Q)
1050 !#H,L$(J,K)," : ",E$(S,P)
1060 NEXT
1070 IF H=1 THEN !#H
1080 IF N=5 OR N=6 THEN RETURN
1090 IF H=0 THEN INPUT "",Z$
1100 RETURN
1110 REM ***** SCAN DATABASE *****
1120 INPUT " ENTER SCAN ARGUMENT ? ",K$
1130 INPUT " DO YOU WANT A HARDCOPY (Y OR N) ? ",Z$
1140 IF Z$="Y" THEN H=1 ELSE H=0
1150 FOR I=1 TO P1:NEXT
1160 M=LEN(K$)-1
1170 U=R-M
1180 F=0
1190 READ #2 %F*(R+2),E$
1200 IF E$(K0,K0)=" " THEN 930
1210 FOR I=1 TO U
1220 J=I+M
1230 IF E$(I,J)=K$ THEN 1260
1240 NEXT
1250 GOTO 1290
1260 GOSUB 970
1270 F1=F1+1
1280 IF Z$="END" THEN 330
1290 F=F+1
1300 GOTO 1190
1310 REM ***** DELETE A RECORD FROM THE DATABASE *****
1320 !
1330 INPUT " ENTER RECORD NUMBER ? ",F
1340 IF F<0 THEN 330
1350 IF F>L THEN 1320
1360 READ #2 %F*(R+2),E$
1370 !N!N!
1380 GOSUB 990
1390 !
1400 INPUT " IS THIS THE CORRECT RECORD TO DELETE (Y OR N) ? ",Z$
1410 IF Z$="Y" THEN 1440
1420 FOR I=1 TO P1:NEXT
1430 GOTO 1330
1440 E$(D9,D9)="#"
1450 WRITE #2 %F*(R+2),E$,NOENDMARK
1460 GOTO 330
1470 REM ***** UPDATE A DATABASE RECORD *****
1480 INPUT " ENTER RECORD NUMBER ? ",F
1490 IF F<0 THEN 330
1500 READ #2 %F*(R+2),E$
1510 !N!N!
1520 GOSUB 990
1530 !
1540 INPUT " IS THIS THE CORRECT RECORD (Y OR N) ? ",Z$
1550 FOR I=1 TO P1:NEXT
1560 IF Z$="Y" THEN 1580
1570 GOTO 1480
1580 FOR Q=1 TO T
1590 J=(Q-1)*15+1
1600 K=J+14
1610 S=S(Q)
1620 P=P(Q)
1630 !L$(J,K)," : ",E$(S,P)
1640 INPUT ".....CHANGE TO ? ",B$
1650 IF B$="" THEN 1670
1660 E$(S,P)=B$
1670 NEXT
1680 IF E$(D9,D9)=" " THEN 1710
1690 INPUT ".....RECORD IS DELETED. RE-INSTATE (Y OR N) ? ",Z$
1700 IF Z$="Y" THEN E$(D9,D9)=" "
1710 WRITE #2 %F*(R+2),E$,NOENDMARK
1720 GOTO 330
1730 REM ***** DISPLAY DEFINITION HEADER *****

```

More

base, L is incremented by 1 and rewritten by line 670. This ensures that the last record pointer in the database definition will be correct even if the program abnormally terminates.

A few words about access times. Each access to the database, either for a key search or a scan, requires a sequential read of the entire database. Needless to say, if the record you are searching for is close to the beginning of the database, it will be found sooner than if it is at the end. Search times will be faster for databases with shorter records. I therefore recommend that the data records be kept as short as possible. I have defined one database that has records that are 77 bytes long. To do a key search for record 50 takes about four seconds. Thus, if that database had 200 records in it, the maximum access time should not be greater than 16 seconds.

One other program is presented here. DBVERIFY is used to verify the database (see Listing 4). With it you can list the database definition from the definition file. It also verifies that the record number in the database definition's next record pointer is correct. If there is a difference, the program will notify you and correct the next record pointer. Sample 4 demonstrates the use of the DBVERIFY program.

Conclusion

To recap, follow these steps to define a new database: first, define the data record on paper, its length, the key and its location in the record, each field and its name and location. Then run DBDEFN. Simply answer its questions as per your definition. Next, run DBFRMT to format the database. Then run DBPROG. Select option 1 initially to load records into the database. Then select any of the other options to manage the data as desired.

I designed this database system to allow me to define various data files and access and maintain them with one supervisory program. The system sacrifices access time to allow duplicate keys and to eliminate the need for an ordered database. Even with its limitations, the program is excellent for cataloging many kinds of data, such as parts lists, recipe lists, personal checks, name and address lists, record album catalogs and household inventories. I've found that its capabilities far outweigh its limitations. ■


```

1740 !N!
1750 !TAB(10), "NAME OF DATABASE - ".X#
1760 !TAB(10), "NO. OF REC. IN FILE - ".L
1770 !TAB(10), "RECORD LENGTH - ".R
1780 !TAB(10), "KEY START POSITION - ".K0
1790 !TAB(10), "KEY STOP POSITION - ".K9
1800 !TAB(10), "POS. OF DEL. FLAG - ".D9
1810 FOR I=1 TO T
1820 IF S(I)=K0 THEN 1860
1830 NEXT
1840 !
1850 GOTO 1880
1860 I=(I-1)+15+1
1870 !N! RECORD KEY IS : ".L$(I-1)+14)
1880 !N!
1890 INPUT " ", Z$
1900 GOTO 350
1910 REM ***** RETRIEVE A RECORD BY RECORD NUMBER
1920 FOR I=1 TO P1:NEXT
1930 INPUT " ENTER RECORD NUMBER ? ".P
1940 IF F<0 OR F>L-1 THEN 1920
1950 !N!
1960 READ #2 %F*(R+2), E$
1970 GOSUB 970
1980 GOTO 330
1990 END

```

***** VERIFY DATABASE *****

ENTER NAME OF DATABASE ? PRS

DO YOU WANT A HARDCOPY (Y OR N) ? Y

DATABASE NAME	-	PRS
NO. OF REC. IN FILE	-	12
RECORD LENGTH	-	28
KEY START POSITION	-	1
KEY STOP POSITION	-	10
POS. OF DEL. FLAG	-	28

LABEL	START	STOP
PART NUMBER	: 1	10
DESCRIPTION	: 11	25
QTY ON HAND	: 26	27

***** END OF DATABASE VERIFY *****

Sample run 4. DBVERIFY is used to verify the database. It lists the database definition and verifies that the next record pointer is correct.



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```

10 REM ***** VERIFY DATABASE *****
20 REM
30 REM CODED BY JOHN E. BAILEY
40 REM SULPHUR, LA APRIL, 1980
50 REM
60 REM ***** PROGRAM NAME IS "DBVERIFY" *****
70 REM
80 DIM A$(15)
90 P1=11
100 FOR I=1 TO P1:NEXT
110 !N! ***** VERIFY DATABASE *****
120 !
130 INPUT " ENTER NAME OF DATABASE ? ".N$
140 IF LEN(N$)<>4 THEN 120
150 F$=N$+"DEFN.2"
160 OPEN #1,F$
170 !N!INPUT " DO YOU WANT A HARDCOPY (Y OR N) ? ".Z$
180 IF Z$="Y" THEN H=1 ELSE H=0
190 FOR I=1 TO P1:NEXT
200 READ #1,L,X$,R,K0,K9,D9
210 !#H," DATABASE NAME - ".X$
220 !#H," NO. OF REC. IN FILE - ".L
230 !#H," RECORD LENGTH - ".R
240 !#H," KEY START POSITION - ".K0
250 !#H," KEY STOP POSITION - ".K9
260 !#H," POS. OF DEL. FLAG - ".D9
270 !#H
280 !#H," LABEL START STOP"
290 IF TYP(1)=0 THEN 340
300 READ #1,A$,S,P
310 !#H," ".A$,": ".%4I,S," ".P
320 IF S=K0 THEN !#H" - KEY" ELSE !#H""
330 GOTO 290
340 IF H=0 THEN INPUT " ",Z$
350 D$=N$+"DATA.2"
360 DIM E$(R)
370 OPEN #2,D$
380 I=0
390 READ #2,E$
400 IF E$(K0,K9)=" " THEN 430
410 I=I+1
420 GOTO 390
430 IF I<0 THEN I=0
440 IF I=L THEN 540
450 !#H\!#H
460 !#H," ***** RECORD COUNTS DO NOT MATCH *****"
470 !#H
480 !#H," NO. OF RECORDS IN DEFN = ".L
490 !#H," NO. OF RECORDS IN DATA = ".I
500 !N!INPUT " TYPE STOP TO AVOID CORRECTING DBDEFN ? ".Z$
510 IF Z$="STOP" THEN 540
520 WRITE #1 %0,I,NOENDMARK
530 !#H\!#H".....DATABASE DEFN UPDATED."
540 !#H\!#H
550 !#H," ***** END OF DATABASE VERIFY *****"
560 CLOSE #1
570 CLOSE #2
580 !#H\!#H
590 END

```

Listing 4. Database verification program DBVERIFY.

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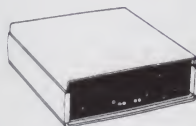
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1411-cc-3m	14 7/8x11" 3 part-Carbonless	500	45.40
1411-cc-4m	14 7/8x11" 4 part-Carbonless	375	46.32
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Thoughts on the 68XX System

By Peter A. Stark

The suggestion has been made that I rename this series, as it really covers much more than just the SWTP computer system. Thus the new name, which more adequately describes the fact that most of the material in these columns applies not just to SWTP mainframes, but to 6800, 6802 and 6809 systems made by others as well.

Real-Time Clock

January's installment described a status line on a video board display, and mentioned several uses for such a line. Let's follow that up a bit more.

There are various status line displays which do not require a real-time clock—for instance, a disk operating system could be easily patched to display the drive, track and sector numbers in a particular spot on the video screen each time it reads or writes a sector.

On the other hand, a real-time clock simplifies the display of other status information. For that reason we should examine what it is.

There is a difference between a clock and a real-time clock. A clock shows the actual time; a real-time clock only indicates passing time. A real-time clock can be compared with a metronome—it ticks like a clock, but it doesn't have a display to show the current time. However, we can figure out how much time has passed from any beginning point by counting how many ticks we have heard.

An actual clock board is quite a bit more complicated than a real-time clock. Several clock boards are available (one is the Microtime board available from several dealers; others are available from JPC Products, PO Box 5615, Albuquerque, NM 87185, and Robertson Electronics, 1003 Warm Sands Drive, SE, Albuquerque, NM 87123). A calendar clock circuit for the 6800 was described in the June 1980 *Kilobaud Microcomputing* (p. 188).

Each of these circuits uses a series of counters like those in a digital watch, which count up by one each second and provide a constant read-out of the current time. In order to avoid losing time when the power is off, most such circuits allow a battery to power the counters so they can continue to run when the rest of the computer is shut down. Once such a clock is set, it continues to indicate the actual time in hours, minutes and seconds (and sometimes the date as well).

A real-time clock, on the other hand, does not indicate the time directly. Instead, it provides ticks which can be used to compute the time if desired (assuming that the time between ticks is precisely known and controlled).

These ticks generally cause IRQ interrupts, which cause the 6800 to temporarily suspend normal programming and jump to an interrupt service subroutine (ISS).

When such an interrupt arrives, it can be used to compute current time, display some system variables or switch between tasks in a multiprogramming system (which is a concept we discussed in the October 1980 installment).

A real-time clock is more than just an oscillator which pulses the IRQ line. It does do that, of course, but it also has circuitry which can turn the clock on and off, so that it does not start to generate clock pulses until the system has an ISS in place and ready. Moreover, since the 6800 might interrupt more than once if the clock pulse were wide enough, the clock board must have circuitry which provides a pulse long enough to be detected even if the 6800 is busy with another job and has its interrupt system temporarily disabled, but turns off the IRQ pulse as soon as the 6800 is actually interrupted. Thus, a real-time clock usually consists of several ICs.

SWTP makes a real-time clock called an MP-T timer, which is programmable and can cause interrupts (ticks) to occur at a wide range of precisely controlled intervals. However, if you want to experiment with a real-time clock, but don't need such precise timing, you can use a spare MP-S serial interface board. (Make sure that it has an IRQ jumper installed.)

When a character is sent to the ACIA in the MP-S by the 6800 proces-

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sor, the ACIA sends it out in serial—one bit at a time—at the baud rate selected by the jumpers on the board. When it has finished sending the character, it turns on the TDRE (transmitter data register empty) bit in its status register. This is how software generally knows when it is time to send the next character. If the MP-S is set to 300 baud, for example, then the TDRE bit will come on 1/30 second after the ACIA receives a character from the 6800.

If, however, the ACIA is properly initialized, it can also generate an interrupt at the same time that TDRE goes on. Consequently, we can use an ACIA to generate a fixed time delay, and then cause an interrupt. If we restart the ACIA as soon as we receive that interrupt, then it will start all over again. Thus, it can provide a constant series of ticks. It need not actually have any I/O device connected to it to do this; in fact, it's better if it is an extra MP-S board in some otherwise unused slot.

Depending on how the ACIA is initialized, we do have some control over the time interval between ticks. This time depends on the baud rate, the number of bits in each character, and the clock divisor used by the ACIA. We'll leave the fine points to you, and consider just a simple case.

Let's assume that we have an MP-S card in port 0; the ACIA uses address 8000 for its control and status register, and address 8001 for data. To initialize the ACIA to turn its interrupts on, we place \$35 into the control register (location 8000); to turn interrupts off, we replace it with \$15.

If we turn on the ACIA's interrupt system and then start the ACIA by placing a data character into its data register, location 8001, it will output that character in serial. When it is finished, it turns on the TDRE bit in the status register (location 8000), sends out a low pulse on the IRQ line to the 6800 and turns on the IRQ bit, bit 7, in the status register (location 8000). A program can test this bit to check whether the interrupt came from the ACIA or somewhere else.

Listing 1 shows an actual program which makes use of this idea. The program consists of two parts—an initialization routine which starts the ACIA going, and an ISS which is called at each tick, and which (among other things) restarts the ACIA.

At location B000, the program resets the ACIA by storing 03 into it; the ACIA does not have a reset pin and so

must get reset by software when first starting up the system.

At location B005, the program stores the address of ISS into address A000, which is the monitor's IRQ vector. This means that when an IRQ occurs, the monitor will steer the computer to execute the ISS program, and thus start the interrupt service subroutine.

After some more initializing (more on that later), at location B01E we store a \$35 into the ACIA's control register to enable its interrupts. This is followed by sending out character \$FF to be printed. Although any character could have been chosen, the \$FF is a rubout which will not be printed even if you have a printer connected to the ACIA. (However, a word of caution—although the ACIA can have an I/O device connected to it, that device must not be used while we are using the MP-S port for a real-time clock!)

Finally, a CLI instruction enables

the interrupt system in the 6800 (it is preceded by a NOP, since some earlier 6800 ICs did not work properly unless CLI and SEI instructions were preceded by NOPs).

At this point, we assume that the initialize routine returns to whatever program called it, and this program continues.

When the ACIA has finished outputting, however, it generates an interrupt. As a result, the above program is interrupted, and the computer comes to the interrupt service subroutine at the entry point ISS.

Since interrupts can come from several places in the computer, we begin by testing whether it in fact came from where we think it came from. This is done at location B02B, where we load the status bits from the ACIA, move the leftmost bit (the IRQ bit, bit 7) into the carry bit and continue to OK if the carry is set.

If the carry is not set, the interrupt came from elsewhere. In that case,

Listing 1. MSCAN program.

```

NAM    MSCAN

* THIS PROGRAM PRODUCES A MEMORY USAGE MAP
* IN THE VIDEO STATUS LINE

* EXTERNAL REFERENCES
A000)  IRQ    EQU    $A000    IRQ VECTOR
8000)  ACIA   EQU    $8000    PORT 0 ACIA
E07E)  PDATA  EQU    $E07E    PRINT STRING ROUTINE
E0E3)  MONITR EQU    $E0E3    MONITOR RETURN POINT
D800)  SCRAM  EQU    $D800    SCREEN RAM START
D010)  TOP    EQU    $D010    USABLE RAM TOP ADDRESS

* INITIALIZE AND START DISPLAY ROUTINE

B000)          ORG    $B000
8000 86 03     INITLZ LDA A #$03
8002 B7 8000    STA A ACIA      RESET ACIA BEFORE STARTING
8005 CE B02B    LDX  #ISS
8008 FF A000    STX  IRQ        INITIALIZE INTERRUPT POINTER
800B CE D800    LDX  #SCRAM     POINT TO START OF SCREEN RAM
800E FF B073    STX  PREV      INIT PREVIOUS POINTER
B011 86 20      LDA A #$20      GET A SPACE
B013 A7 00      ERASE STA A 0,x  ERASE NEXT BYTE
B015 08         INX
B016 8C D850    CPX  #$D850     END OF LINE?
B019 26 F8      BNE  ERASE      NO
B01B FF D010    STX  TOP        YES; RESERVE A LINE
B01E 86 35      LDA A #$35      INIT ACIA CR TO 00110101
B020 B7 8000    STA A ACIA
B023 86 FF      LDA A #$FF
B025 B7 B001    STA A ACIA+1    START ACIA ACTION
B028 01         NOP
B029 0E         CLI            ENABLE INTERRUPTS
B02A 39         RTS

* INTERRUPT SERVICE SUBROUTINE

B02B B6 8000    ISS  LDA A ACIA  TEST FOR INTERRUPT
B02E 48         ASL A
B02F 25 19      BCS  OK         IF CAUSED BY TIMER

```

More →

Listing 1 continued.

```

B031 86 15      LDA A #15      TURN OFF ACIA INTERRUPT
B033 B7 8000     STA A ACIA
B036 CE B03F     LDX #ERRMSG   OTHERWISE PRINT ERROR MESSAGE
B039 BD E07E     JSR PDATA
B03C 7E E0E3     JMP MONITR
B03F 41          ERRMSG FCC 'ACIA ERROR'
B049 04          FCB 4

B04A 30          OK          TSX          TRANSFER STACK PTR TO INDEX
B04B E6 05       LDA B 5,X     GET PC HI
B04D 54          LSR B
B04E 54          LSR B          MOVE MSB TO RIGHT
B04F 54          LSR B
B050 54          LSR B
B051 F1 B074     CMP B PREV+1
B054 27 17       BEQ SAME      SKIP IF SAME AS PREV
B056 FE B073     LDX PREV      POINT TO PREV DIGIT
B059 86 20       LDA A #20
B05B A7 00       STA A 0,X     ERASE IT
B05D F7 B074     STA B PREV+1  POINT TO NEW LOCATION
B060 CB 30       ADD B #30     CHANGE DIGIT TO ASCII
B062 C1 3A       CMP B #3A     IS IT 0-9?
B064 25 02       BCS NUMBER   YES
B066 CB 07       ADD B #07     NO, CHANGE TO A-F
B068 FE B073     LDX PREV      POINT TO NEW LOCATION
B06B E7 00       STA B 0,X     MODIFY IT
B06D 86 FF       LDA A #FF     RESTART ACIA
B06F B7 8001     STA A ACIA+1
B072 3B          RTI          AND RETURN

B073          PREV RMP 2      POINTER TO PREVIOUS LOCATION

END

```

ner of the screen which indicates what addresses are currently being used by the running program. When a program which is located in the range of 1000-1FFF is running, for example, the screen shows the display

.1.....

(except that the screen has blank spaces rather than periods). If a program located up in the 6000 area is running, then the display is

.....6.....

If the programs were rapidly jumping back and forth to each other, then the display would be

.1....6.....

with the 1 and 6 flashing alternately. By observing this kind of display, we can get an idea whether programs are running correctly.

In this particular version, we assume that the screen RAM starts at location D800 (which is called SCRAM in the program) and that the top line is reserved for status. Locations D800-D84F are used for status, and the regular display starts at D850. The video driver we described in January requires that location D010 be set to D850 to achieve this.

With this as a background, let's see how the program works.

During initialization, the SCRAM address of D800 is placed into location PREV, which is used to indicate the previous digit displayed in the map.

The next part of the program, at location B011-B019, erases the 80-byte top line of the display, and then the number D850 is placed into TOP to tell the video driver not to use the top line. All of this is, of course, sandwiched between the ACIA initialization we discussed earlier.

Each time an interrupt occurs, the computer goes to the ISS routine. After some preliminaries, it reaches OK at location B04A, where the TSX instruction moves the contents of the stack pointer (plus 1) into the index register. Five bytes up is the first half of the program counter, which tells us the address of the instruction which would have been performed next had there been no interrupt. This is loaded into the B register.

A series of LSR (logical shift right) instructions moves the leftmost hex

we turn off the ACIA interrupt system by putting 15 into it (at location B031), print an error message and jump to the monitor.

If the interrupt really came from our real-time clock, then we continue at OK. After some more processing, we restart the ACIA by sending another \$FF to it in location B06D, and execute an RTI, or return from interrupt. This returns to the main program, which will execute until the next interrupt tick comes. In this case, we get about 30 interrupts per second if the ACIA is set for 300 baud.

This explains how we can use an extra MP-S interface's ACIA as a simple real-time clock. Now what can we do with it?

Program MSCAN

January's article showed how to reserve an extra status line on a Percom video board display. The same idea can be applied to any of the many other video boards available. Listing 1, called MSCAN, is a program which makes use of this to produce a memory usage map as other programs are running.

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digit to the right, and it is now compared with the right byte of PREV. Because the screen memory starts at an even boundary of D800, if the PC started with 0 we want to display 0 at location D800, and so on, up to F at location D80F if the PC started with F.

Since PREV points to the previous digit's location, we can look at its rightmost byte to determine what digit is currently being displayed. If it is still the same, the program simply goes to SAME, resets the ACIA and exits. By not updating the screen when the display is not changing, we avoid unnecessary flicker.

If the new PC address starts with a different digit from the previous one, then we update the display. First, at B056 we point the index register to the location of the previous digit and then replace it with a space to erase it. Then we change PREV by storing the leftmost digit of the PC (which has been in the B accumulator all this time) into its second byte. The next few instructions convert this digit into ASCII. Finally, at location B068, we point the index register to the new location (which is now in PREV) and

store the new ASCII character in that spot. Then we restart the ACIA and return from the interrupt to the main program.

Variations on this program can be used to display other useful facts in the status line of the display; just add the additional steps where SAME is.

Even if keeping a status line is of no interest to you, if you have a video board then this is a simple program which can give you a little experience using interrupts.

Programming the 2732 EPROM

The 2732 4K×8 EPROM (which is not the same as TI's TMS-2532) is sufficiently similar to the 2716 that it can be programmed with the SWTP MP-R programmer. Only three wiring changes and some program changes are required. (I covered 2708 programming on p. 82 of the February 1980 issue of *Kilobaud Microcomputing*.)

The 2732 pin functions differ from the 2716 in several ways. First, pin 21 (which is called Vpp on the 2716 and gets +25 V during programming) now gets A11, an additional address bit. To implement this change, cut

the copper trace which goes from diode D1 to pin 21 of the EPROM socket and also cut the trace connecting R7 to pin 12 of IC3. Then connect EPROM pin 21 to IC3, pin 12, and connect the cut lead of R7 to IC3, pin 9. (This changes the control bit for the +5 V supply, but that is taken care of by software.)

Next, pin 20 of a 2716 is an active low chip select, whereas pin 20 of a 2732 is a combination \overline{OE}/V_{pp} pin which is to be low normally, but at +25 V during programming. To implement this change cut the trace connecting pin 20 of the EPROM socket to IC3, pin 5, and connect pin 20 instead to the anode side of diode D2.

Next, make sure that a 0.1 μ F disk capacitor has been installed in parallel with R6, as instructed in an addendum to the SWTP instruction sheets.

One more caution is in order. The Intel 2732 EPROM requires +25 V for Vpp, which is supplied by the MP-R board. However, the Intel 2732A EPROM (note the A after the 2732!) requires only 21 V and can be damaged if more than 21.5 V is applied. If you are using the 2732A, you

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must include some additional regulation—perhaps using a Zener diode—to limit Vpp.

Next, make the changes shown in Listing 2 to the SWTP program. These change the buffer size and the sequencing of the power to supplies and programming pulses.

Finally, save the modified program from 0020 through 07E1, with a starting address of 0100.

Video Boards as Terminals

One of the unexpected expenses in setting up an SS-50 bus system is the need for a terminal. This is one of the factors which often swing a newcomer in the direction of a Radio Shack or Apple system, since the price of an SS-50 system plus a terminal usually exceeds the price of an all-in-one system.

Needless to say, a serial terminal is not absolutely needed; a video board and parallel keyboard can do the job as well, and at much lower cost.

Making the video board and the keyboard work with standard programs requires two separate interfaces—one software, the other hardware.

0037	OFFF	CHANGE BUFFER END ADDRESS
0422	86 10	TURN ON ONLY +5 VOLTS
044D	86 10	TURN ON ONLY +5 VOLTS
0479	86 10	TURN ON ONLY +5 VOLTS
04A8	BD 07C0	JSR TO PATCH 1
04AB	01	
04C6	BD 07D0	JSR TO PATCH 2
04C9	01	
0561	86 90	+5V ON, +25V ON, CE' PULSED LOW
0573	86 B0	+5V ON, +25V ON, CE' BACK TO HI
0580	86 30	+5V ON, +25V OFF, CE' KEPT HI
* PATCH 1 - TURN ON +25 VOLTS BEFORE PROGRAMMING		
07C0	86 20	+5V ON, CE' HI
07C2	97 26	STORE IT
07C4	BD 05D6	JSR TO PIA PULSING ROUTINE
07C7	86 B0	+5V ON, +25V ON, CE' STILL HI
07C9	97 26	
07CB	BD 05D6	JSR TO PIA PULSING ROUTINE
07CE	39	AND RETURN
* PATCH 2 - TURN OFF 25 VOLTS AT END OF PROGRAMMING		
07D0	86 30	+5V ON, +25V OFF, CE' HI
07D2	97 26	
07D4	BD 05D6	JSR TO PIA PULSING ROUTINE
07D7	BD 04FE	WAIT 10 SECONDS
07DA	86 10	+5V ON, +25V OFF, CE' BACK TO LOW
07DC	97 26	
07DE	BD 05D6	JSR TO PIA PULSING ROUTINE
07E1	39	AND RETURN

Listing 2. SWTP programmer modifications.

For terminal output, standard 68xx software simply outputs via a serial board in port 1. Although older systems use a PIA (in a circuit which is a

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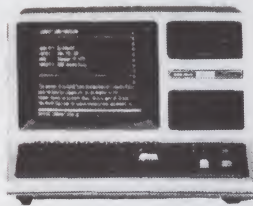


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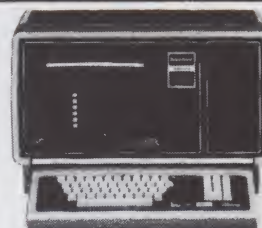
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relic of MIKBUG days), the modern approach is to use an ACIA circuit such as that of the SWTP MP-S serial card. The terminal output routine—part of the ROM monitor and usually called OUTEEE—consists of three essential steps (two to check whether the ACIA is busy, and one to output the actual character) plus a few extra instructions which pick up the port address and configure the ACIA for proper output. The rest of the terminal functions—scrolling, moving the cursor, etc.—are taken care of by the terminal itself.

When using a video board, these ancillary functions must be taken care of by software. As described in January's article, scrolling is sometimes partially handled by video board hardware, and sometimes completely done by software. In either case, however, an extensive amount of software is needed to do the job.

When a separate terminal is used in addition to the video board, it is feasible to keep this software on tape or disk and load it into the computer's RAM each time the computer is turned on. But when no terminal is present, then the video board software must be located in ROM; moreover, it must be linked to the monitor program so that it is automatically brought up as power is turned on. In other words, a special monitor program must be used with the video board in that case.

Fortunately, a monitor does exist for every current video board being made—Gimix has GMXBUG, Thomas has JOEBUG, and Percom's video board is supported by my HUMBUG monitor (described in the August 1980 installment and available from Star-Kits). Using a video board, then, simply involves getting the appropriate monitor ROM to handle it.

Parallel keyboard input, on the other hand, is not so easy. The standard procedure is to connect the keyboard through a parallel interface, such as the SWTP MP-LA card. The seven-bit data from the keyboard goes into the data port, while the data strobe bit goes into one of the PIA handshaking lines on the port. Since the PIA is intended for just such parallel inputs, this is a good hardware match. (On disk systems this PIA interface would be used instead of an ACIA interface; on tape systems both may be required—one for the keyboard and the other for the tape interface.)

But there is usually some software

required as well. Since the routine needed to initialize and input from a PIA differs from that needed for an ACIA, the INCH or INEEE routine must also be different.

As before, if a serial terminal is available, then this revised routine could be on tape or disk and entered into RAM at power-up. But lacking a terminal, the routine must also be part of the monitor in ROM so that it is operational as soon as power comes on. Some of the video-based monitors have it; some don't. But there is more to it than that.

Much user software—like BASIC interpreters, editors, disk operating systems, assemblers, etc.—monitors the keyboard, waiting for a break character such as a control-C. This function is usually performed directly by each program, rather than going

through the monitor.

When a PIA is used with a parallel keyboard, each such program must be patched to monitor the PIA rather than the standard ACIA. Not only is this a tedious job (for example, the instruction manual for the Gimix video board has 15 pages of patches and does not even cover all the possible programs), but it also means that the patched software is nonstandard and may not run on other systems. This is a definite liability, since one of the prime differences between SS-50 bus systems and S-100 systems has traditionally been the compatibility between different systems.

There is, of course, a solution. Don't use a PIA at all, but interface the parallel keyboard through an ACIA. This makes the interface truly transparent to all software and avoids

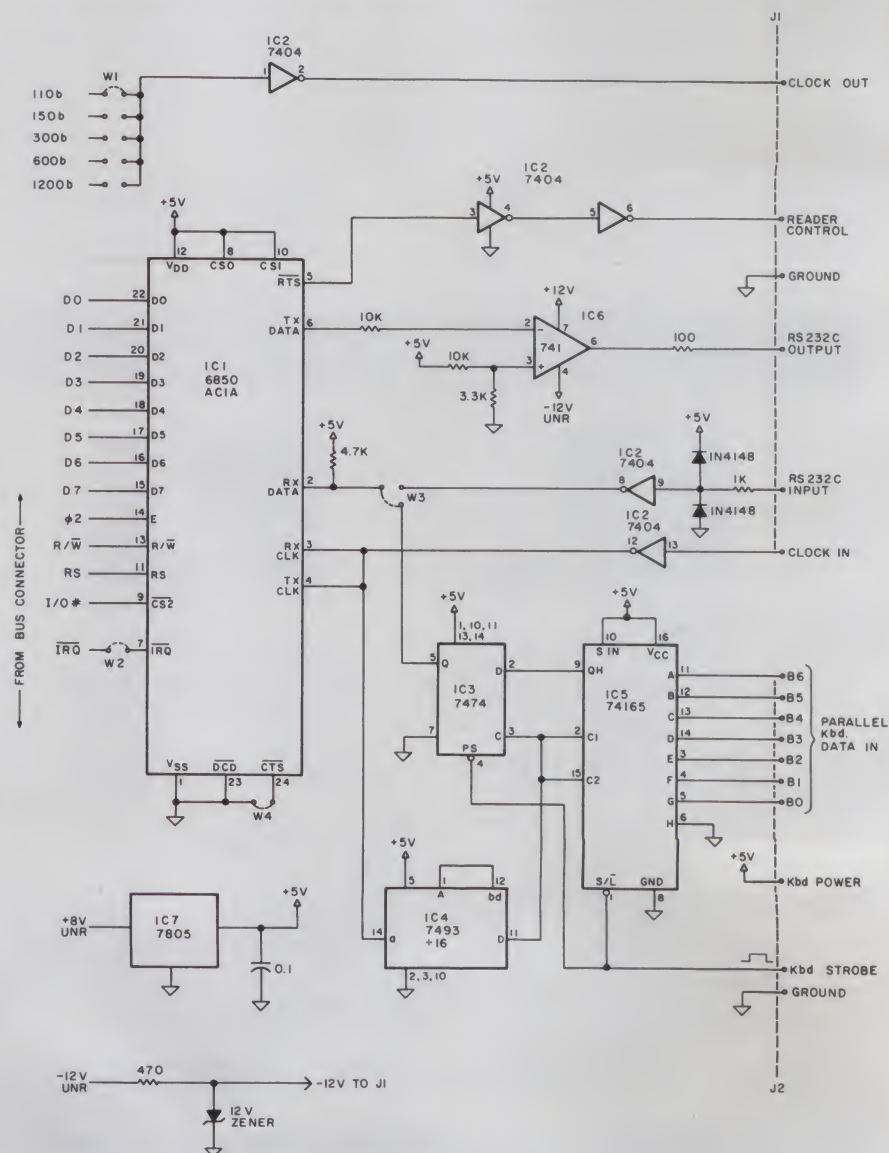


Fig. 1. Serial/parallel interface design.

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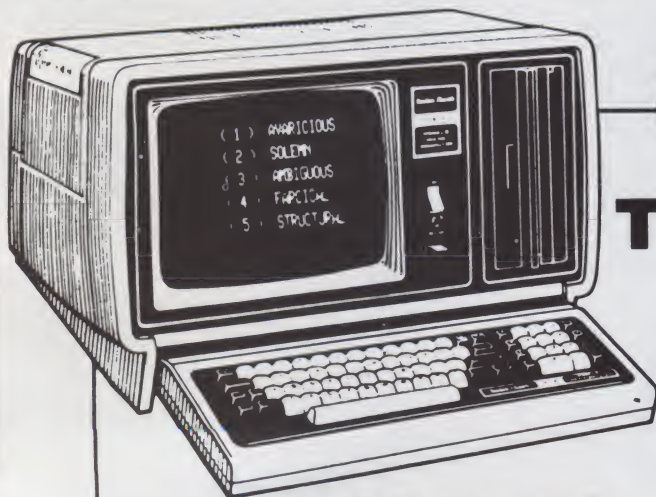


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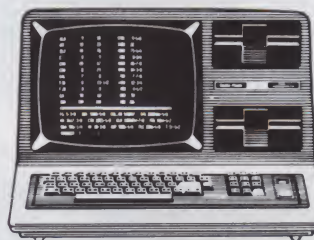


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all incompatibilities. (And, in those systems which use interrupts for keyboard input—such as some of the sophisticated disk operating systems or multitasking systems—this approach is almost mandatory.)

On the surface that sounds impossible, but actually all it requires is that the parallel output of the keyboard be converted to serial, and that this serial signal then be fed to the ACIA as if it came from a terminal.

One approach is to put a parallel-to-serial converter right into the keyboard enclosure and use serial output directly. George Risk Industries makes such an adapter for their GRI keyboards, and similar adapters are also available from Electronic Systems and elsewhere. Though this simplifies the wiring between the keyboard and computer, it requires a more complicated power supply in the keyboard. Moreover, it is not necessarily an economical approach.

The second approach is to combine the serializer with the ACIA port together on one 30-pin interface card. Since the ACIA (and a UART, if used) would require TTL buffering of their I/O signals anyway, combining the parallel-to-serial conversion function on the same circuit board can solve the problem without any increase in circuitry by combining buffering and data conversion in the same set of ICs.

An excellent circuit for a serial/parallel interface board is shown in Fig. 1. This circuit provides not just a parallel keyboard input, but also a full RS-232C I/O port; either of these may be used individually, or both may be used together.

As Fig. 1 shows, a 6850 ACIA is used as in most other serial interfaces. It connects directly to the 30-pin I/O bus of the computer (with jumper W2 being used only when interrupt operation is desired).

Jumper W1 is used to select one of the baud rates; the desired baud rate clock is then buffered via a 7404 and sent out to the RS-232C interface connector. In the printed circuit board layout in Fig. 2, this connector is pin-for-pin compatible with that used on the SWTP MP-S card, and the clock is brought out so it may be used for terminal baud rate switching or for tape interface operation.

The clock input signal is again buffered and sent to pins 3 and 4 of the ACIA. In normal operation, the clock out and the clock in pins on the interface connector should be jumpered together. The buffering is included to eliminate data errors often present when an SWTP MP-S interface is separated from a tape interface by more than a foot or two of cable.

Serial RS-232 data is buffered with a 741 op-amp for output, and with another section of a 7404 inverter for input. The reader control line is also buffered by two inverters. Since this interface does not provide current-loop operation, this circuitry is much simpler than on other serial interfaces.

The major difference is in the circuit at the bottom. The seven bits of keyboard data (no parity bit is used) are sent to a 74165 shift register. This IC has eight inputs, one of which (pin 6) is permanently grounded to provide the 0 start pulse which always precedes a serial character.

The output of the shift register, on pin 9, goes to IC3, part of a 7474 type D flip-flop, which is normally kept set by a low on the PS (pre-set) input. The output of this flip-flop on pin 5 is thus normally high (representing a 1) between characters.

Since the ACIA requires a baud rate clock 16 times the actual baud rate, whereas the 74165 shift register requires a clock at the same baud rate, a 7493 divider divides the clock by 16.

The keyboard strobe must be normally low, with a high pulse extending over an entire one-character interval; that is, if the ACIA runs at 300 baud, then the strobe pulse must last for at least 1/30 second; at 1200 baud, it must last at least 1/120 second. This strobe pulse is normally low, which keeps the 74165 from shifting and keeps the 7474 set; when a character is received it goes high, which allows the 74165 and 7474 ICs to pass the data to the ACIA. (The serial input of the 74165, pin 10, is connected to +5 V so that the shift register fills up

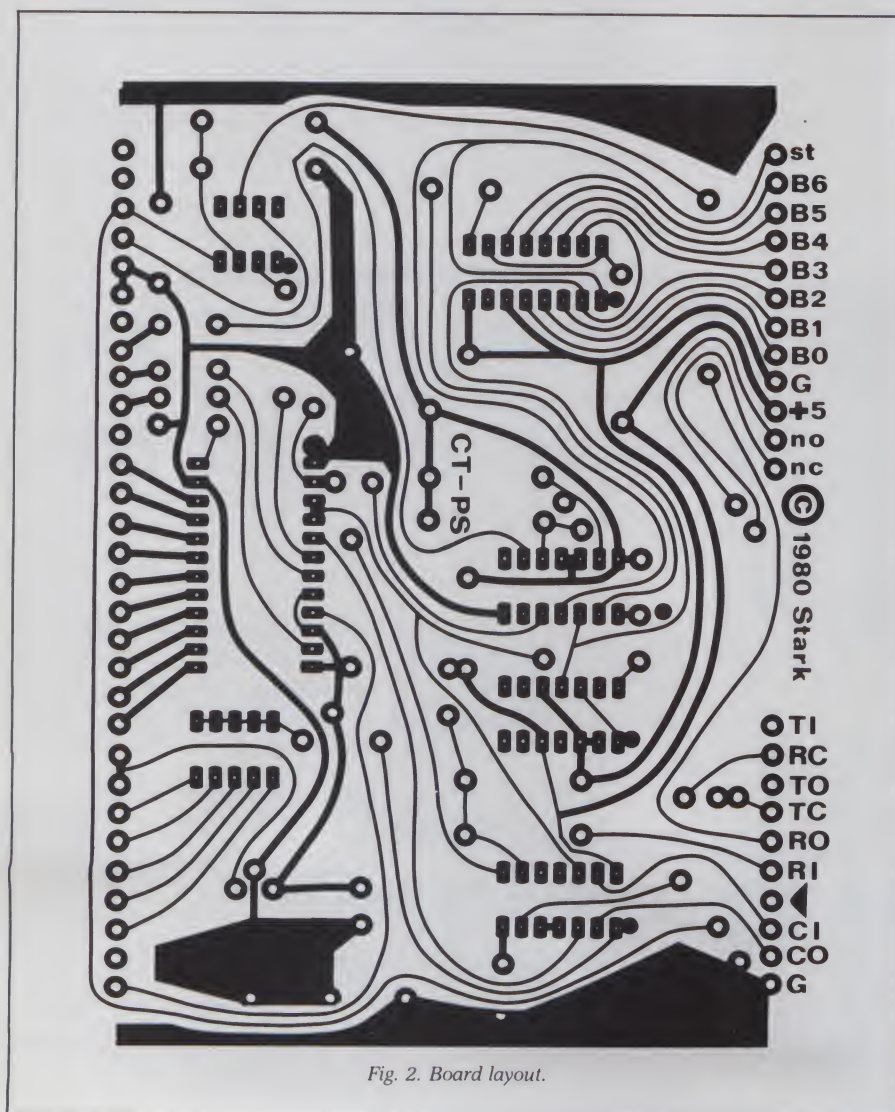


Fig. 2. Board layout.

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6800 system.)

The basic trainer has a 6800, a 1K monitor in a 6830 ROM, 256 bytes of RAM (with sockets for 256 bytes more), a 17-key numeric keyboard, six-digit seven-segment LED readout, and a prototyping socket for doing the hardware experiments in the Heath microcomputer course. The circuitry of the trainer is specially buffered to simplify hardware interfacing, and the unit runs at a clock frequency of about 400 kHz to eliminate timing problems which might otherwise hamper some of the experiments. (Heath is also marketing a less expensive trainer which lacks the prototyping socket and buffering, and is intended only for software experiments.)

Heath also sells an add-on unit to the trainer, which adds from 1K to 4K more RAM, Tiny BASIC in ROM and a serial and cassette interface. Though this makes it possible to run BASIC on the system, it does not really allow much expansion beyond that.

Several readers have written for help in expanding the ET-3400 trainer into a full-fledged SS-50 bus system and asked me to devote an article to the subject. I cannot really recommend such a step. Even if it were completed, the trainer would only act as a CPU board; external memory and I/O interfacing, as well as a motherboard and power supply, would still be needed. With the large number of 6800 CPU boards available on the used market, it would certainly be easier, and cheaper as well, to sell the Heath trainer and start with a used but real SS-50 bus system.

Conversion of the trainer to run a full-fledged system involves four aspects:

1. The 6830 ROM must be replaced by a monitor which supports a serial terminal and is compatible with existing 6800 software. Several monitors (such as MIKBUG or SWTBUG) were available in a 6830 ROM, or else a 2708 or 2716 monitor could be adapted. With a 6830 some read-dressing is needed, since the trainer's 6830 EPROM occupies addresses FC00-FFFF, whereas standard monitors require E000-FFFF. With a 2708 or 2716, though, additional decoding would be needed, since the 6830 has five chip selects, while the 2708 or 2716 has only one. Either way, this would make the keyboard and LED readout on the trainer inoperable. While a custom monitor to allow

both a serial terminal and the Heath I/O gear could be written, it is not worthwhile.

2. The 256-byte RAM on the board must be disabled so that a larger external memory can be substituted.

3. More extensive buffering for an external bus must be added, and some mechanical arrangement provided to mount the trainer and a motherboard together. The mechanical work would be a kludge.

4. External memory and a serial port must be added. While these could be added on the prototyping socket, there isn't enough room for more than a few K of memory; besides, a more permanent arrangement would be desirable.

6800 Systems

Although SWTP has switched production from 6800 systems to 6809 systems, there are still several manufacturers who market 6800 systems and components. Not only are 6800 systems still popular with industrial users, who need systems to go with software they already have, but with hobbyists as well.

If you are in either category, here are some companies to contact:

Febe group (51 Hamilton Ave., York, PA 17404) makes a cabinet with motherboard, power supply and keyboard for either 6800 or 6809 systems.

Gimix, Inc. (1337 West 37th Place, Chicago, IL 60609) makes a hefty cabinet, motherboard and power supply, as well as both 6800 and 6809 CPU boards and other accessories.

Thomas Instrumentation (168 Eighth St., Avalon, NJ 08202) makes motherboards and other components, including a 6802 CPU board. The 6802 is compatible with the 6800 and runs the same programs.

Percom Data Co. (211 N. Kirby, Garland, TX 75042) also makes a 6802 CPU board.

And don't forget the 6802 single board computer featured in the Kilo-baud Classroom series published in this magazine.

6800/6809 Magazines

Several times I have mentioned the 68 Micro Journal (3018 Hamill Road, Hixson, TN 37343) in these pages. It specializes in 6800/6809 material. A newer magazine is the SS-50 Newsletter (PO Box 402, Logan, UT 84321). It is a slicker, easier to read magazine, whose content is improving as time goes on. ■

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Protect Your Files From Prying Eyes

By Phil Hughes

Most microcomputers offer little protection against unauthorized access to data. There is, however, a way to ensure data privacy. Encryption will change a message into a form that is unintelligible to anyone without the converting information.

Most of us probably played with a simple form of encryption when we were children. For example, we might have written a note by converting each letter of the alphabet to the letter following it. Thus, Mary, I like you a lot. John became

NBSZ, J MJLF ZPV B MPU. KPIO.

Although this message is obscure at first, it is easy to decipher. The single letters J and B are the clues. English has only two single-letter words, so B and J represent A and I. Decoding should take only a couple of minutes.

Generating Encrypted Messages

With a computer system, you should be able to generate encrypted messages that are much more difficult to decrypt.

One simple method is to use an exclusive OR (XOR) to replace each character in the message with a character in a key (see Table 1). If this is done with a message in ASCII code, an assortment of printable and non-printable (control) characters is produced.

For example, encrypt the word MARY using the key 3ZRB. First convert the ASCII characters to their binary equivalents. Using a conversion

table, you get Example 1.

If you execute an exclusive OR on these two lines, the result is shown in Example 2.

Now comes the real advantage of XOR. The XOR operation is symmetrical; applying it a second time will undo what it did the first time. See Example 3.

If you try to apply this encryption method, you may run into trouble with what the operating system does with the control codes that are generated. This happened to me with the Flex operating system. I decided, therefore, to only encrypt the printable characters, and leave the control codes, such as carriage return, as they were.

Thus, I also had to cause the resulting characters to have values greater than the valid control codes. My final algorithm is shown in Example 4.

Also, the length of the key is generally shorter than the message. I handled this by reusing the characters in the key as many times as required to complete the encryption. For example, if the message is

```
MARY = 0100 1101 0100 0001 0101 0010 0101 1001
3ZRB = 0011 0011 0101 1010 0101 0010 0100 0010
```

Example 1. Converting ASCII characters to their binary equivalents.

```
0111 1110 0001 1011 0000 0000 0001 1011
```

Example 2. Executing an exclusive OR.

THIS IS A SECRET

and the key is

HIDE

then the character-by-character XOR is performed by repeating HIDE the required number of times. Thus,

THIS IS A SECRET!

HIDEHIDEHIDEHIDEH

Programs

Listing 1 is an implementation of this encryption method in 6800 assembler language. Most of the program is for interfacing to the file management system, getting the parameters and checking for errors. The actual encryption takes place in lines 209-220.

Listing 2 is an example using Crypt. First, using the build utility, you create a data file named Message. You then list the contents of the file, using

```
result = 0111 1110 0001 1011 0000 0000 0001 1011
3ZRB = 0011 0011 0101 1010 0101 0010 0100 0010
```

```
result in:
          0100 1101 0100 0001 0101 0010 0101 1001
```

which is MARY.

Example 3. Applying XOR to the result in Example 2, using the encryption key.

```
IF NOT control character THEN
  Subtract hexadecimal 20 from character
Perform XOR
Add hexadecimal 20 to result
```

Example 4.

Phil Hughes, PO Box 2847, Olympia, WA 98507.


```

++BUILD MESSAGE
=This is the message.
=It will be encrypted and then it will
=be decrypted.
=Watch what happens.
=#
++LIST MESSAGE
This is the message.
It will be encrypted and then it will
be decrypted.
Watch what happens.

+++CRYPT,MESSAGE,HIDDEN,FRAMUS
++LIST HIDDEN
!(>u:5r5Z0s+72>44#!
!s1;-!u1#r$6!?'*5(1s'<%m!;#<a$!s1;-!
!#rX(6!?'*5(1)
96;fX);!s,31=0=5!

+++CRYPT,HIDDEN,FOUND,FRAMUS
++LIST FOUND
This is the message.
It will be encrypted and then it will
be decrypted.
Watch what happens.

```

Listing 2. Using Crypt.

```

+++CRYPT,MESSAGE,F1,WEIRD
+++CRYPT,F1,F2,STRANGE
++LIST F2
Pur`*us:r`s+crdsvoy-
_i rpn`!r`$b(bvvhkgot <hr6fry#`!<t{zo
s!`hdsu)wad`?
Dkdcra~jz7bsxyma8

+++CRYPT,F2,G1,STRANGE
+++CRYPT,G1,G2,WEIRD
++LIST G2
This is the message.
It will be encrypted and then it will
be decrypted.
Watch what happens.

+++CRYPT,F2,H1,WEIRD
+++CRYPT,H1,H2,STRANGE
++LIST H2
This is the message.
It will be encrypted and then it will
be decrypted.
Watch what happens.

```

Listing 3. Encrypting Message, using the key Weird and the key Strange.

the list utility. Next, you encrypt Message into the file Hidden, using Framus as the key. The contents of Hidden show little resemblance to the original contents of Message.

Finally, Crypt is run once again,

this time using Hidden as input, Found as output and—again—Framus as the key. Listing Found shows that the message has been restored to its original form.

For those wishing to make the mes-

sage even harder to decode, Crypt can be repeated using different keys. Listing 3 shows Message being encrypted, first using the key Weird and then the key Strange. Because of the symmetry of the XOR operation, the decryption can be performed in either order. This is also demonstrated in Listing 3. ■

Listing 1. Implementation of encryption method in 6800 assembler language.

```

1      0000      NAM  CRYPT      - File encryption utility
2      0000      OPT  XRF
3
4      * Copyright 1979, Specialized Systems Consultants
5      *
6      * COMMAND:
7      *   CRYPT,filespec1,filespec2,key
8      *
9      *   where filespec1 is the input file
10     *   filespec2 is the output file and
11     *   key is the encryption key
12
149     0000      OPT  PNT
150
151     0078      * KBLN EQU 120      key buffer length
152
153
154     0000      CRYPT EQU *
155     3R 0000 CE 0154 LDX #RFCB
156     12 * 0003 BD AD2D JSR GETFIL      input file
157     16 * 0006 24 03 (000B) BCC $10
158     3R 0008 7E 00A6 JMP ERROR
159     2R 000B 86 01 $10 LDA A #FEXT.TXT default ext
160     11 * 000B BD AD33 JSR SETEXT
161     14 * 0010 CE 0294 LDX #WFCB
162     23 * 0013 BD AD2D JSR GETFIL      output file
163     27 * 0016 24 03 (001B) BCC $99
164     3R 0018 7E 00A6 JMP ERROR
165     2R 001B 86 01 $99 LDA A #FEXT.TXT default ext
166     11 * 001D BD AD33 JSR SETEXT
167
168     14 * 0020 CE 00DC * Get the key
169     16 * 0023 5F LDX #KEYBUF
170     25 * 0024 BD AD27 CLR B
171     29 * 0027 24 0E (0037) JSR NXTCH
172     3R 0029 CE 00CA BCC GKOK
173     12 * 002C BD AD1E LDX #BKMSG      bad key
174     15 * 002F 7E AD03 JSR PSTRNG
175     9R * 0032 BD AD27 JMP WARMS
176     13 * 0035 25 0A (0041) JSR NXTCH      get character
177     2R 0037 5C BCS GKDONE      end of key
178     4 * 0038 C1 78 INC B
179     8 * 003A 2C ED (0029) CMP B #KBLN      too long?
180     6R 003C A7 00 BGE BADKEY      yes
181     10 * 003E 08 STA A 0,X      save char
182     14 * 003F 20 F1 (0032) INX
183     2R 0041 81 0D BRA GKLOOP      get next char
184     6 * 0043 27 05 (004A) CMP A #X'D'      valid terminator?
185     4R 0045 B1 AC02 BEQ GKTERM      yes
186     8 * 0048 26 DF (0029) CMP A F2E0L
187     5R 004A F7 00D9 BNE BADKEY      no
188     * Open the files STA B KEYLEN      save
189     8 * 004D CE 0154 LDX #RFCB

```

More

XOR	0	1
0	0	1
1	1	0

Table 1. Truth table for exclusive OR (XOR). The result is 1 if the two inputs have different values and 0 if the two inputs are the same.

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Listing 1 continued.

190	10	0050	86	01	LDA A #F20PR	read
191	16	0052	A7	00	STA A #B2FNC,X	
192	25	* 0054	BD	B406	JSR FMS	
193	29	0057	26	4D (00A6)	BNE ERROR	
194	2R	0059	86	FF	LDA A #X'FF'	disable
195	8	005B	A7	38	STA A #B2SCF,X	space comp
196	11	005D	86	0294	LDX #WFCB	
197	13	0060	86	02	LDA A #F20PW	write
198	19	0062	A7	00	STA A #B2FNC,X	
199	28	* 0064	BD	B406	JSR FMS	
200	32	0067	26	3D (00A6)	BNE ERROR	
201	2R	0069	86	FF	LDA A #X'FF'	disable
202	8	006B	A7	38	STA A #B2SCF,X	space comp
203	11	006D	CE	00DC	LDX #KEYBUF	point to key
204	17	0070	FF	00DA	STX KBPTR	
205	21	0073	F6	00D9	LDA B KEYLEN	key char count
206	3R	0076	CE	0154	LDX #RFCB	
207	12	* 0079	BD	B406	JSR FMS	get char
208	16	007C	26	22 (00A0)	BNE CHKSTAT	
209	5R	007E	FE	00DA	LDX KBPTR	
210	7	0081	81	20	CMP A #X'20'	
211	11	0083	28	06 (008B)	BMI \$40	
212	2R	0085	80	20	SUB A #X'20'	
213	7	0087	A8	00	EOR A 0,X	
214	9	0089	88	20	ADD A #X'20'	
215	4R	008B	08		INX	
216	6	008C	5A		DEC B	
217	10	008D	26	06 (0095)	BNE SVPTR	
218	4R	008F	F6	00D9	LDA B KEYLEN	restore key length
219	7	0092	CE	00DC	LDX #KEYBUF	and buffer ptr
220	6R	0095	FF	00BA	SVPTR	
221	9	0098	CE	0294	STX KBPTR	
222	18	* 009B	BD	B406	LDX #WFCB	
223	22	009E	20	06 (0076)	JSR FMS	put char
224					BRA LOOP	get next
225	5R	00A0	E6	01	* Check status	
226	7	00A2	C1	08	CHKSTAT	LDA B #B2ESB,X
227	11	00A4	27	03 (00A9)	CMP B #8	get status
228	9R*	00A6	BD	AD3F	BEQ DONE	EOF?
229					ERROR	JSR RPTERR
					* Close files	report error
230	3R	00A9	CE	0154	DONE	LDX #RFCB
231	5	00AC	86	04		LDA A #F2CLF
232	11	00AE	A7	00		STA A #B2FNC,X
233	20	* 00B0	BD	B406		JSR FMS
234	24	00B3	27	03 (00B8)		BEQ \$20
235	9R*	00B5	BD	AD3F		JSR RPTERR
236	3R	00B8	CE	0294		LDX #WFCB
237	5	00BB	86	04		LDA A #F2CLF
238	11	00BD	A7	00		STA A #B2FNC,X
239	20	* 00BF	BD	B406		JSR FMS
240	24	00C2	27	03 (00C7)		BEQ \$40
241	9R*	00C4	BD	AD3F		JSR RPTERR
242	3R	00C7	7E	AD03		JMP WARMS
243					\$40	close error
244					*	return to U.S.
245					* DATA AREA	
246					*	
247		00CA	2A2A20494E56		BKMSG	CON C'** INVALID KEY',4
248		00B9			KEYLEN	RMB 1 key length
249		00BA			KBPTR	RMB 2 buffer pointer
250		00BC			KEYBUF	RMB KBLEN key buffer
251		0154			RFCB	RMB 320 input FCB
252		0294			WFCB	RMB 320 output FCB
253		03D4			*	END CRYPT
AD36	ADDBX	137				
0029	BADKEY	172	179	186		
00CA	BKMSG	246	172			
00A0	CHKSTAT	225	208			
AD21	CLASS	130				
AD00	COLDS	119				
0000	CRYPT	154	253			
AD4B	DOCMND	144				
00A9	DONE	230	227			
00A6	ERROR	228	158	164	193	200
AC00	F2BACK	78				
AC29	F2CCOL	109				
AC28	F2COMF	108				
AC18	F2CURC	96				
AC07	F2DEC	85				
AC01	F2DEL	79				
AC03	F2DEPC	81				
AC08	F2EJC	86				
AC02	F2ENV	111				
ACU2	F2EOL	80	185			
AC16	F2ERR	95				
AC2U	F2ERRT	102				
AC0A	F2ESC	88				
A840	F2FCB	113				
AC26	F2FIA	107				
AC2F	F2FIEF	112				
AC24	F2FOA	106				
AC23	F2INSW	105				
AC11	F2LAST	92				
AC14	F2LBP	94				
A080	F2LBUF	77				
AC1B	F2LDAO	99				
AC1A	F2LINE	98				
AC2B	F2MEND	110				
AC05	F2NULL	83				
AC22	F2OTSW	104				
AC09	F2PAUS	87				
AC19	F2PREC	97				

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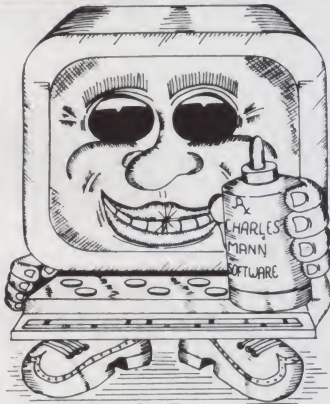
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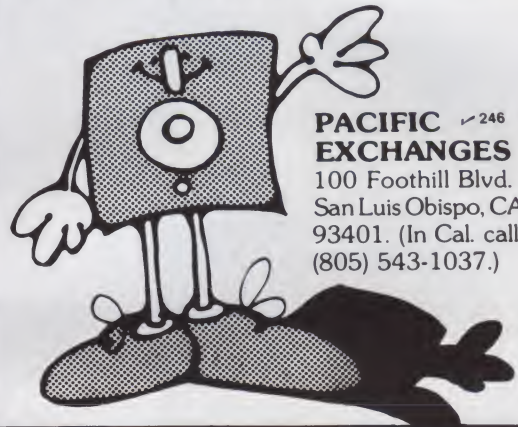
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AC0B	F2SDRV	89				
AC21	F2SIOF	103				
AC06	F2TABC	84				
AC1D	F2TRAN	100				
AC1E	F2TRNA	101				
A100	F2UCA	114				
AC12	F2UCTA	93				
AC0C	F2WDRV	90				
AC04	F2WIDC	82				
0002	FB2ACT	41				
004U	FB2HUF	59				
002F	FB2CDA	56				
0020	FB2CRN	52				
001E	FB2CUR	51				
0003	FB2DRV	42				
0013	FB2EDA	47				
0001	FB2ESB	40	225			
000C	FB2EXT	44				
000F	FB2FAT	45				
0032	FB2FDP	57				
001C	FB2FLP	50				
0000	FB2FNC	39	191	198	232	238
0022	FB2INX	53				
0004	FB2NAM	43				
0024	FB2NWB	55				
0023	FB2RDX	54				
003B	FB2SCF	58	195	202		
0011	FB2SDA	46				
0015	FB2SIZ	48				
0017	FB2SMI	49				
0008	FEXT.BAC	70				
0005	FEXT.BAK	67				
0003	FEXT.BAS	65				
0000	FEXT.BIN	62				
0002	FEXT.CMD	64				
0007	FEXT.DAT	69				
0009	FEXT.DIR	71				
000B	FEXT.OUT	73				
000A	FEXT.PRT	72				
0006	FEXT.SCR	68				
0004	FEXT.SYS	66				
0001	FEXT.TXT	63	159	165		
0000	FL2IO	16				
0016	FM2BOR	35				
0004	FM2CLF	20	231	237		
000C	FM2DLF	27				
0014	FM2FND	33				
0007	FM2GIR	23				
0011	FM2GRB	31				
000F	FM2NSS	29				
0006	FM2OPD	22				
0001	FM2OPR	17	190			
0003	FM2OPU	19				
0002	FM2OPW	18	197			
0010	FM2OSI	30				
0008	FM2PIR	24				
0015	FM2POS	34				
0012	FM2PRB	32				
000D	FM2RNF	28				
0009	FM2RSS	25				
0005	FM2KWF	21				
000A	FM2WSS	26				
B400	FMINIT	145				
B406	FMS	147	192	199	207	222 233 239
B403	FMSCLS	146				
AD15	GETCHR	126				
AD2D	GETFIL	134	156	162		
AD42	GETHEX	141				
0041	GKDONE	183	176			
0032	GKLOOP	175	182			
0037	GKOK	177	171			
004A	GKTERM	187	184			
AD1B	INBUFF	128				
AD09	INCH	122				
AD0C	INCH2	123				
AD48	INDEC	143				
0078	KBLEN	151	178	249		
00DA	KBPTR	248	204	209	220	
00DC	KEYBUF	249	168	203	219	
00D9	KEYLEN	247	187	205	218	
AD30	LOAD	135				
0076	LOOP	206	223			
AD27	NXTCH	132	170	175		
AD45	OUTADR	142				
AD0F	OUTCH	124				
AD12	OUTCH2	125				
AD39	OUTDEC	138				
AD3C	OUTHEX	139				
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0154	RFCB	250	155	189	206	230
AD3F	RPTERR	140	228	235	241	
AD2A	RSTRIO	133				
AD53	SETEXT	136	160	166		
0095	SVPTR	220	217			
AD03	WARMS	120	174	242		
0294	WFCB	251	161	196	221	236

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Faster Baud Rate For the Superboard II Cassette

By James A. Antonelli

Being the owner of a Superboard II computer has its drawbacks. The hardware and software people seem never to have heard of OSI, and magazine articles are few.

So when I wanted to speed up my program-loading time, I found that I had to do it myself.

Some of my programs are 8K long. At 300 baud, loading can take as long

as five minutes. I could have gone to disk but didn't have the money. So after studying the schematics in the user's manual, I came up with this idea.

The Circuit

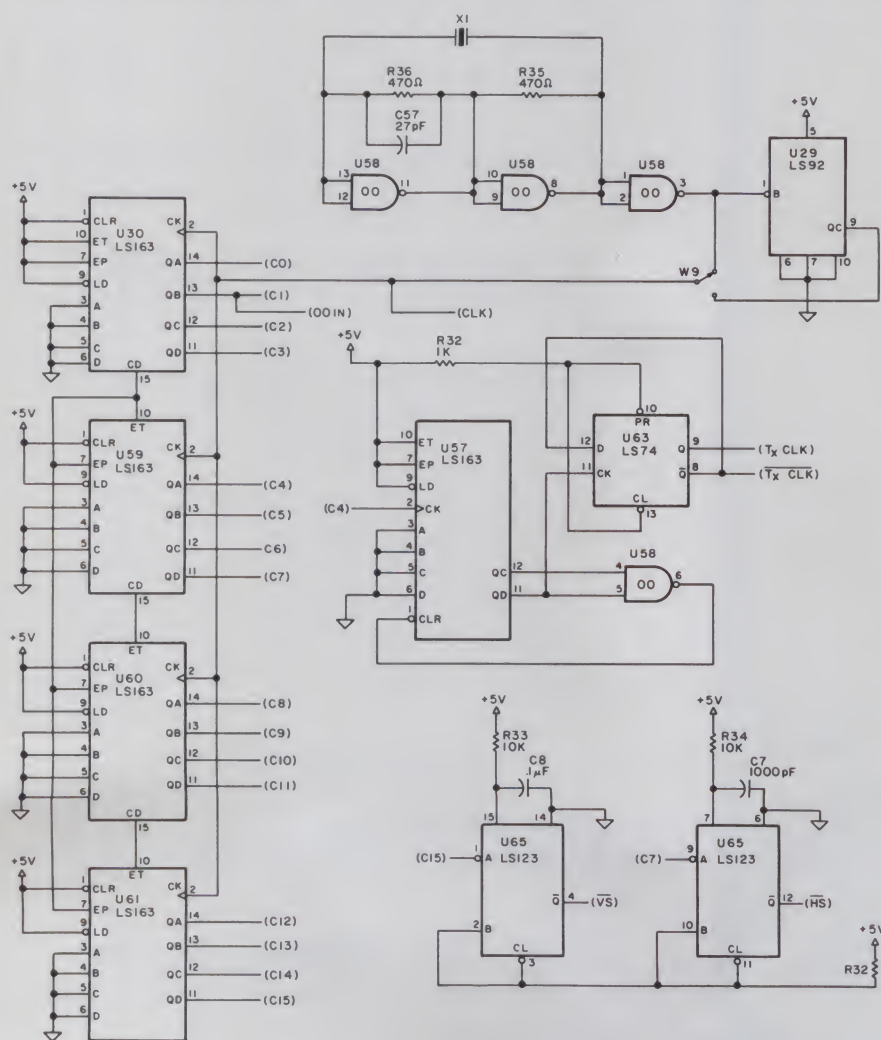
As can be seen in Fig. 1, the clock circuit U58 is divided into separate clock frequencies by U30, U59, U60 and U61. The chips we will be concerned with are U30, U57 and U59. Chip U57 receives clocking from U59, as can be seen in Fig. 1. Pin 2 of U57 connects to pin 14 of U59; this setup gives us the 300 baud rate.

First, to double the frequency or baud rate, cut the foil running to pin 2 near U57. Exercise care when cutting, to avoid damaging other traces.

When this foil is cut and all material is removed from the 600 board, you are then ready to proceed to the next step. You will need shielded cable, wire cutters and a small soldering iron (see parts list). If you also want to keep the 300 baud rate, then skip step 2 and go on to step 3.

Second, for a 600 baud rate only, you need to install a jumper wire from U30, pin 11, to U57, pin 2. You will also have to remove R53 and install a jumper here. It is advisable to ground the shielded cable at the nearest ground. Pins 3, 4, 5 and 6 of U57 are all grounded so you can ground the cable here. You can ground each end of the cable if you wish. I only grounded one end and haven't run into any problems yet.

After you have completed steps 1 and 2, skip to the alignment section,



step 4.

Step 3 requires a little more work, but you will have a choice between 300 and 600 baud. You will have to determine where you want to mount SW1. I mounted mine in the front, above the keyboard. Then measure the single conductor shielded cable from here to U57, leaving a few extra inches. Cut and strip insulation and tin ends. Solder this to the center position of SW1.

Now measure your second wire. Cut and strip insulation and tin ends. This one goes to U30. You can now solder this wire to the switch also, either to the top or to the bottom (see Fig. 2).

Now measure your last wire. This one goes to U59. Cut and strip insulation and tin ends. It is a good idea to tape all of the wires together. It makes a neater project, and servicing is easier.

One other note: make sure you identify the wires. Either mark them with a colored tape, wire numbers or any other method that will make them easy to identify. Solder this wire in the remaining lug on the switch, which should now only have three lugs left. These should all be on the opposite side. If not, go back to the beginning of step 3. It is a good idea to now go over your solder joints.

Cut two pieces of solid wire about six inches long. Strip about one inch of insulation. Wrap one of these wires around SW1, the bottom lug. The opposite end of this wire goes to the end lug of R1. With the wire remaining, twist this and the other wire from the two-conductor cable to the center lug of SW1 and the end lug of R1. This completes the switch.

The next step is to locate and remove R53 on the board (see Fig. 3). It is located near U69, pin 7.

The only wire left is the two-conductor shielded cable. Solder one of these wires, after cleaning the holes from the resistor R53. Don't forget to solder the top and bottom of the board. These are plated-through holes, but sometimes the plate is damaged when removing parts. The wire remaining can now be soldered in place.

This completes the board. Check for solder bridges and/or bad solder joints. If everything is OK, then lay the switch on the side and cut one

more piece of solid wire to about six inches in length. Strip all but three inches of insulation.

On the edge of the 600 board there should be a ground, and a few holes through this ground strip. If your particular board doesn't have these holes, you'll need to drill two holes here. Now insert the solid wire from the top, and after bending the wire bring this wire back up through the remaining hole. This will be used for holding the wires that were soldered previously. Route all wires to this point and, with the remaining solid wire, wrap this. This will keep the wires from being pulled off the foil. Your finished product should look quite professional.

The Alignment

Fourth, set the switch on nonconductive material. Turn your computer on; you should see the LED light up. If not, shut it off and recheck. If you have a frequency counter, alignment will be easy. If not, then enter the following simple program:

```
10 For I=0 to 32: For A=0 to 24: print "A";
next A: next I.
```

Now type in the command word SAVE, and run. Depending on the position of SW1, it will print letters A at the regular speed of 300 baud, or they will be printed at 600 baud.

As this program is being run, switch SW1 back and forth. There should be a difference in speed at which the As are being printed. Once you know which position is 300 baud

(it should be in the up position), mark it. It doesn't really make any difference where the 300 or the 600 baud is, just so you will know.

Get a blank tape and make a change in the program to:

```
10 For I=0 to 100: For A=0 to 24: print "A";
NEXT A: NEXT I
```

This should give enough recording time. Set SW1 to 600 baud, start the tape recorder and let the program run until it is completed. Flip SW1 to 300 baud and start the tape recorder. Let the program run until it is also completed.

You should now have two recordings, one at 600 baud and one at 300 baud. Rewind the tape and type in NEW, and enter this program:

```
10 Load: INPUT A$: GOTO 10.
```

One resistor, R57, has to be located on the 600 board. On my particular board, it is the blue one located near the rear of the board. Once you have located this resistor, enter RUN on the computer and start the tape recorder. Slowly turn until you start getting As printed on your monitor.

Once you get a consistent load (none of the As are being dropped out and you haven't received a syntax error message), leave R57 alone. Repeat the above load program a few times to be sure of the 600 baud rate. When you believe everything is OK, then let the tape advance to the second recording and set SW1 to 300 baud rate. Once again type in RUN. You will now have to adjust R1 until

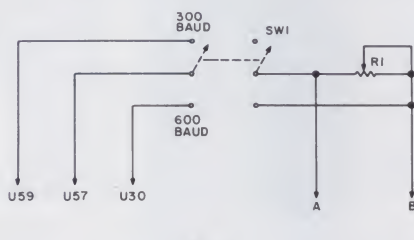


Fig. 2.

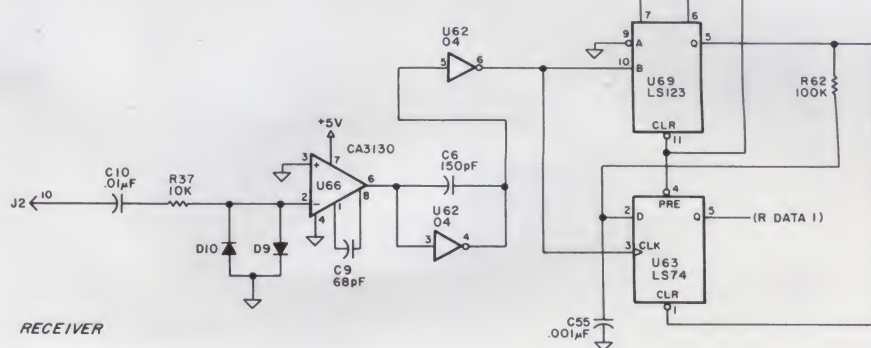


Fig. 3



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you get a consistent loading of As. Redo until you think everything is OK. Flip SW1 to 600 baud and try this position again. Sometimes you'll need to make very small adjustments to R57, but remember: any adjustment to this resistor also means an adjustment to R1. If everything is OK, then mount SW1 and enjoy rerecording your programs at double the speed.

I made this conversion nearly a year ago, and I haven't had to make any adjustments whatsoever. I highly recommend using a quality tape for the 600 baud rate. Using cheap tape may result in drop-outs; you then have to reload with your back-up tape (300 baud) and have gained nothing! ■

Parts List

Two-conductor shielded cable
Single-conductor shielded cable
10k mini trimpot
2PDT mini switch
Stranded hook up wire
Solid hook up wire
Small soldering iron, solder, etc.

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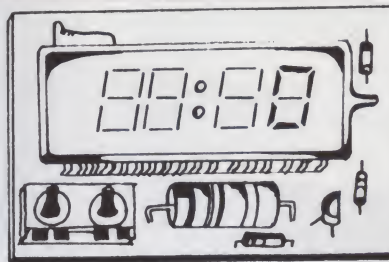
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An Adventure In Free Enterprise

By Forest E. Myers

It started innocently enough. I had just finished a general program that could, among other things, generate mailing labels from a DATBAS file. My brother-in-law asked if I would be willing to do some labels for a friend. A week or two later, the friend called asking about prices. Needless to say, I was taken aback by the prospect of having a paying customer. Thus began my adventure in the mailing label business.

The program, which serves as the focus of this article, is called Labels, and is an extension of two previously-published programs: Screen (*Microcomputing*, April 1980) and Fileit (*Microcomputing*, May 1980). It lets you print more than one DATBAS record

across a page. This reduces the amount of paper used when dumping a data file. By making the program more general, selected items can be output from data base records. Presto, change-o, a mailing label generator.

A Market for Labels

If you've looked closely at your mail lately, you have seen the extent to which gummed labels are used. There are business firms that specialize in mailing list maintenance, update and envelope services. For large-volume users, these companies offer a very cost-effective method of relieving the burden associated with large mailings.

For small-volume users, however, these services are prohibitively expensive. The large services have a required minimum on the number of labels in a run. As a result, the small mailer must buy a several-months' supply of address labels to reach the minimum level. Invariably, addressees change over time and the labels become stale.

Therefore, the small mailer must hand-write address labels or use copy machine labels. The former takes an inordinate amount of time. The latter is difficult to update and hard to maintain in any prearranged sequence.

A niche, therefore, exists for the microcomputer owner. There is a market to be supplied, one that consists of real estate agents, manufacturers' representatives, churches, bowling leagues, small businesses and so on.

To tap this market requires a little hustling. Contact friends and tell them about your service. Visit local establishments and, if the budget will permit, take out occasional newspaper ads. Look for trade magazines whose readers could be potential customers. Many times the advertisement rates in these publications are low and give you wide exposure for little cost. Mailings are another tool for telling others of your entry into the mailing label business.

Address correspondence to Forest E. Myers, 5114 Garnett St., Shawnee, KS 66203.

Program listing.

```
10 FILL 12890,145 : REM LET BASIC PRINT OUT A 145 CHARACTER LINE
20 CLOSE (0,E) : CLOSE (1,E) : CLOSE (2,E) : CLOSE (3,E)
30 DIM A$(256),B$(10),C$(10),D$(256),E$(512),C(30),F(30)
40 DIM R(30),L(30),F$(256)
50 DIM G$(256),T$(256)
60 DIM R$(256),L1(30)
70 DIM D(30),N1(30)
80 DIM D1(30),T(30)
90 "" : REM CLEAR SCREEN AND HOME CURSOR
100 FOR I=1 TO 7 : "" : NEXT I
110 "" : LABEL PROGRAM""
120 A$="" : FOR I=1 TO 8 : A$=A$+A$ : NEXT I
130 D$=A$ : B$=A$(1,10) : C$=B$ : E$=A$+D$ : F$=A$
140 G$=A$ : T$=A$
150 R$=A$
160 R$=A$(1,1)
170 FOR I=1 TO 5 : "" : NEXT I
180 INPUT "Enter DATBAS file name ",B$
190 INPUT "Enter drive no. where DATBAS file can be found ",D1
200 B$=B$+"."+D1+CHR$(0)
210 OPEN (2,E,B$,2,D1)
220 GET (2,E,A$,0)
230 C$=A$(241,242) : CONVERT C$ TO Z : REM NUMBER OF LABELS IN FILE
240 C$=A$(243,244) : CONVERT C$ TO L1 : REM STARTING CRT LINE
250 C$=A$(245,246) : CONVERT C$ TO B1 : REM BLOCKING FACTOR
260 C$=A$(247,249) : CONVERT C$ TO D : REM LENGTH OF RECORD
270 C$=A$(250,252) : CONVERT C$ TO Z3 : REM NUMBER OF RECORDS IN FILE
```

More →

However, before spending a lot of time, effort and money in this area, consider the likelihood that your envelope will be thrown in the trash before it is opened. My own experience tells me never to send letters to real estate agents. They are bombarded with every type of sales pitch. Letters stand little chance of spurring interest. A visit to the office may produce more results. Be careful, though. Your visits may be viewed as business soliciting, and you may run afoul of local laws prohibiting soliciting without a license. Check with city officials before you make your calls.

Finally, before you visit, work up a small sales pitch and practice it on an unsuspecting friend, wife or family pet so you don't waste your potential customers' time. Also, work up a small reminder card or sales poster so if they want to use your service in the future, they will know where to reach you.

Pricing the Service

Having tackled the problem of contacting potential customers, how do you price your service? Depending upon the extent of your services, you can levy charges in several areas. The first is a data entry charge, which is for entering the name and address information into your microcomputer and storing it for future use. My advice is to set your price to cover wear and tear on your machine and the time you spend entering data. For instance, I charge 5 cents a label for data entry.

With DATBAS and a list of addresses where street name, city, state and ZIP code change infrequently (addressee and street number change each time), Karen, my cohort, can average 100 labels an hour (\$5 an hour). This fee is well below that charged by larger firms, which may run as much as 16 cents per label. You can charge less, since your overhead is much lower than theirs.

Next, you can charge for updates, corrections and even sorting the address file to customer specification. For corrections and update, I charge the data entry fee. I do sorts for free. However, since my typical customer doesn't use bulk mail, I've had few requests to sort address files into any particular order. Deletions from the address file are done for free. This encourages clients to purge their files of outdated and unneeded records.

The label charge, for the labels themselves, is where the money is

Program continued.

```

280 C=A*(253,256) : CONVERT C% TO R : REM MAX RECORDS FILE CAN HOLD
290 W=Z
300 FOR I=1 TO Z
310 C=A*(I*2-1,I*2) : CONVERT C% TO L(I) : REM LENGTH OF INDIVIDUAL SCREEN LABELS
320 C=A*(119*I+2,120*I+2) : CONVERT C% TO D(I) : REM LENGTH OF INDIVIDUAL DATA FIELDS
330 NEXT I
340 FOR I=1 TO 2
350 GET (2,E,A#,I)
360 E*(I*256-255,I*256)=A# : REM BRING IN LABEL TEXT
370 NEXT I
380 GET (2,E,A#,3)
390 FOR I=1 TO Z
400 C=A*(I*2-1,I*2) : CONVERT C% TO R(I) : REM CRT ROW ADDRESS FOR SCREEN LABEL
410 C=A*(119*I+2,120*I+2) : CONVERT C% TO C(I) : REM CRT COLUMN ADDRESS FOR SCREEN LABEL
420 NEXT I
430 FOR I=1 TO Z : N1(I)=D(I) : NEXT I
440 S1=1
450 GOSUB 2100
460 C1=0
470 D3=0
480 CURSOR 15,0
490 "Enter label line, position for data field (1,p) ";
500 FOR I1=1 TO Z
510 CURSOR R(I1),C(I1)+L(I1) : REM POSITION CURSOR BEHIND CRT LABEL
520 INPUT D$
530 " " : REM BLANK OUT LEFTOVER CURSOR PROMPT
540 Z2=D(I1)-LEN(D$) : FOR Q7=1 TO Z2 : " " : NEXT Q7
550 D3=D3+D(I1)
560 CURSOR R(I1),C(I1)+L(I1)
570 " " :
580 IF D$="99,99" THEN EXIT 760
590 IF LEN(D$)=0 THEN 750
600 C1=C1+1
610 B$=D$
620 FOR I=1 TO LEN(D$)
630 IF B$(I,I)=", " THEN EXIT 650 : REM FIND ", " SEPARATING ADDRESS LABEL LINE AND LINE POSITION
640 NEXT I
650 C=B$(1,I-1)
660 CONVERT C% TO L1(C1) : REM SAVE ADDRESS LABEL LINE ADDRESS
670 D1(C1)=I1 : REM SAVE THE SCREEN LABEL NUMBER
680 X=LEN(D$) : REM FIND LENGTH OF USER INPUT
690 C=B$(I+1,X) : REM CONVERT INFO AFTER ", " TO NUMERIC DATA FOR RELATIVE LINE POSITION
700 CONVERT C% TO T
710 T=T*.01
720 L1(C1)=L1(C1)+T : REM ADD ADDRESS LINE AND RELATIVE LINE POSITION TOGETHER
730 D(C1)=D(I1) : REM STORE DATA FIELD LENGTH ASSOCIATED WITH USER SELECTED SCREEN LABEL
740 D4(C1)=D3
750 NEXT I1
760 Z=C1 : F0=0
770 FOR I=1 TO C1 : F0=F0+D(I) : NEXT I
780 REM F0 TOTAL LENGTH OF FIELDS SELECTED
790 REM SORT THE USER INPUT INTO ORDER SO THAT ADDRESS LABELS WILL COME OUT AS SPECIFIED.
800 FOR I=1 TO Z-1
810 FOR J=I+1 TO Z
820 IF L1(I)<L1(J) THEN 920
830 T=L1(I) : L1(I)=L1(J) : L1(J)=T
840 T=D(I) : D(I)=D(J) : D(J)=T
850 T=D4(I) : D4(I)=D4(J) : D4(J)=T
860 L1(I)=L1(J) : D1(I)=D1(J)
870 D(I)=D(J)
880 D4(I)=D4(J)
890 L1(J)=T : D1(J)=T1
900 D(J)=T2
910 D4(J)=T3
920 NEXT J
930 NEXT I
940 REM CALCULATE THE BEGINNING AND ENDING POSITION FOR EACH LINE IN ADDRESS LABEL
950 REM CALCULATE THE NUMBER OF LINES IN THE LABEL -- 10 MAX
960 REM D5 BEGINNING POSITION OF ADDRESS LABEL LINE
970 REM D6 ENDING POSITION OF ADDRESS LABEL LINE
980 REM Y9 KEEP TRACK OF NUMBER ADDRESS LABEL LINES
990 REM C2 NUMBER OF LINES IN ADDRESS LABEL
1000 D5=1 : D6=0 : Y9=1
1010 FOR I=1 TO Z
1020 D6=D6+D(I)
1030 IF INT(L1(I))>>INT(L1(I+1)) THEN 1050
1040 GOTO 1070
1050 D5(Y9)=D5 : D5=D6+1
1060 D6(Y9)=D6 : Y9=Y9+1
1070 NEXT I
1080 C2=1
1090 FOR I=2 TO Z
1100 IF INT(L1(I-1))>>INT(L1(I)) THEN C2=C2+1
1110 NEXT I
1120 " "
1130 INPUT "Selection criteria to be used (Y/N) ",C#
1140 IF C#="Y" OR C#="y" THEN S9=1 : GOSUB 1830
1150 " "
1160 INPUT "Enter number of labels per line ",L8
1170 INPUT "Enter number of lines between labels ",L6
1180 FOR I=1 TO L8
1190 "For label";X3I;I;" "
1200 INPUT "enter printer column label is to begin ",T(I)
1210 NEXT I
1220 L5=1
1230 INPUT "Enter beginning record for label output ",B0
1240 "There are";Z5I;Z3;" records currently in the file"
1250 INPUT "Enter ending record for label output ",E0
1260 E1=INT(B0/B1) : E2=B0-E1*B1 : IF E2>0 THEN E1=E1+1
1270 E1=E1+4 : REM BEGINNING DISK BLOCK TO BE READ FOR OUTPUT
1280 IF E2=0 THEN E2=B1
1290 E3=INT(E0/B1) : E4=E0-E3*B1 : IF E4>0 THEN E3=E3+1

```

More

Program continued.

```

1300 E3=E3+5 : Z0=B0 : REM ENDING DISK BLOCK TO BE READ FOR OUTPUT
1310 E5=G5+F5
1320 FOR I=E1 TO E3
1330   GET (2,E,A5,I)
1340   FOR J=E2 TO B1
1350     IF Z0=E0+1 THEN 1490
1360     D9=1 : D4=0
1370     IF S9=0 THEN 1490
1380     IF S7=1 THEN 1450
1390     D5=F5
1400     FOR W=1 TO S8
1410       D5(D2(W)-D3(W)+1,D2(W))=A5(J*D-D+D2(W)-D3(W)+1,J*D-D+D2(W))
1420     NEXT W
1430     IF G5=D5 THEN 1530
1440     GOTO 1620
1450     FOR W=1 TO S8
1460       IF G5(D2(W)-D3(W)+1,D2(W))=A5(J*D-D+D2(W)-D3(W)+1,J*D-D+D2(W)) THEN EXIT 1490
1470     NEXT W
1480     GOTO 1620
1490     IF Z0=E0+1 THEN L8=L5-1 : GOSUB 1690 : EXIT 1660
1500     D1=0
1510     REM THE CODE TO FOLLOW BUILDS ONE ADDRESS LINE FOR ALL LABELS ACROSS THE LABEL CARRIER
1520     REM WHEN L5 INDICATES WHEN LINE IS BUILT FOR ALL LABELS DUMP THE LINE TO THE PRINTER
1530     FOR I1=1 TO Z : REM NOTE Z NOW HOLDS THE NUMBER DATA FIELDS COMPRISING THE ADDRESS LABEL
1540       D1=D4(I1)
1550       D2=D1-D(I1)+1
1560       D4=D4-D(I1)
1570       E5(L5*F0-F0+D9,L5*F0-F0+D4)=A5(J*D-D+D2,J*D-D+D1)
1580       D9=D4+1
1590     NEXT I1
1600     L5=L5+1
1610     IF L5=L8+1 THEN L5=1 : GOSUB 1690
1620     Z0=Z0+1 : REM NUMBER OF LABELS OUTPUT
1630     NEXT J
1640   NEXT I
1650   NEXT I
1660   CLOSE (2,E)
1670   W"End of processing"
1680   END
1690   REM PRINT LABELS
1700   OPEN (PRINTER,E)
1710   D1=0
1720   S1=0
1730   I2=1
1740   FOR I1=1 TO C2 : REM C2 HOLDS NUMBER OF ADDRESS LABEL LINES
1750     W" "
1760     FOR I3=1 TO L8 : REM L8 HOLDS NUMBER OF LABELS ACROSS LABEL CARRIER
1770       WTAB(T(I3));E5(I3*F0-F0+D5(I1),I3*F0-F0+D6(I1));
1780     NEXT I3
1790   NEXT I1
1800   FOR L9=1 TO L6 : W" " : NEXT L9
1810   CLOSE (PRINTER,E)
1820   RETURN
1830   REM SELECTION CRITERIA ROUTINE
1840   W""
1850   W" Note: Up to 3 data fields can be used to limit records output"
1860   W" "
1870   INPUT "Enter number of selection criteria ",S8
1880   IF S8<1 OR S8>3 THEN S9=0 : RETURN
1890   INPUT "Must all selection criteria be met (Y/N) ",C5
1900   IF C5="N" OR C5="n" THEN S7=1
1910   GOSUB 460
1920   CURSOR 15,0
1930   W"Enter selection criteria at '?' above ";
1940   S6=1 : D1=0 : D7=0
1950   FOR I=1 TO W9
1960     CURSOR R(I),C(I)+L(I)
1970     INPUT D5
1980     Z2=N1(I)-LEN(D5) : FOR I2=1 TO Z2 : W" " : NEXT I2
1990     D1=D1+N1(I)
2000     W" ";
2010     CURSOR R(I),C(I)+L(I) : W" ";
2020     IF LEN(D5)=0 THEN 2070
2030     D3(S6)=N1(I) : D2(S6)=D1 : D6=N1(I)-1
2040     G5(D1-D6,D1)=D5
2050     S6=S6+1
2060     IF S6=S8+1 THEN EXIT 2090
2070     NEXT I
2080     IF S6<S8+1 THEN U9=1 : GOTO 1830
2090     RETURN
2100   REM SCREEN PRINT ROUTINE
2110   W"" : REM THIS WILL CLEAR SCREEN AND HOME CURSOR
2120   D1=0
2130   J1=1
2140   FOR I1=1 TO W9
2150     CURSOR R(I1),C(I1)
2160     K1=J1+L(I1)-1
2170     W5(J1,K1);
2180     W" ";
2190     J1=K1+1
2200     D1=D1+N1(I1)
2210     IF S1=1 THEN 2270
2220     FOR M1=1 TO N1(I1)
2230       W"x";
2240     NEXT M1
2250     GOTO 2270
2260     W5(J*D-D+(D1-(D(I1)-1)),J*D-D+D1);
2270     NEXT I1
2280     S1=0
2290     RETURN

```

made. I charge 3 cents per label. One firm I know charges 2.7 cents per label per thousand. If you buy your labels in large quantities, your label cost will be around .02 cents per label. Once label data is entered, you incur only label costs—the rest is gravy.

If you really become involved in the mailing business, you can offer envelope services. This entails collating and folding materials to be mailed, stuffing envelopes, affixing postage and actually mailing materials.

Finally, there is a delivery charge for getting the finished product to your customer. To remain competitive, about the only thing you can do here is recover out-of-pocket costs.

The Program

The DATBAS programs mentioned earlier make Labels a relatively small program. They relieve the Labels program from file creation and update operations. Labels' only function is to output selected portions of DATBAS files to labels.

Labels first requests the name and drive location of the file requested. Next, a data entry screen is presented, and the program asks you to enter the line and position on the line of each data field to be included in the output label. (If the data field is not to be output, you input a RETURN or ENTER.) A prompting "?" will move through the CRT display until all data fields in the file are exhausted.

Next, you are asked if selection criteria to limit output are to be specified. If so, you enter "Y." You can specify up to three criteria. As with the data specification process phase described previously, you are presented with a CRT display of the data fields in the file. You enter the selection criteria in response to the prompting "?". If a particular data field is not to serve as a selection criterion, you input a RETURN or ENTER. When you have input the previously specified number of criteria, a request is made if "all" or "any one" criterion needs to be met by the record for its output to labels.

Next, you make a request to specify the number of labels across the page or label carrier, the number of print lines between labels and the beginning print position for each label on the carrier. The latter process is similar to setting the tabs on a typewriter. With the entry of this information, you are asked to specify the range of

records in the data file to be read for possible label output. Labels are then output to the system printer.

The flexibility of Labels is shown in Listing 1. One, two, three and four labels across are presented. Of particular interest is the way data field orders can be varied among the label sets.

The program listing for Labels is included. Variable descriptions and remark statements have been included to aid those who might want to use Labels for their own purposes. ■

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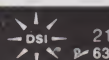
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Microcomputer Selection And Implementation

By Bruce T. Pace

In our work as consultants, we've helped many small-businessmen and professionals travel the road to microcomputer system selection and implementation. These are people who, although lacking technical backgrounds, recognize the microcomputer potential, but are unprepared for the onslaught of technical specifications, buzzwords and the variety of products and vendors.

The need for vendor-independent consulting has naturally arisen from a marketplace which lacks true standardization and occasionally masks incompetence with mystique. The intent of this article is to remove the computer mystique and present guidelines to more clearly define the computer selection process.

A Question of Definition

A problem immediately arises when defining a computer system. For some, a given configuration of hardware constitutes a computer system. For many, it is the integration of hardware and software. But those in business who have purchased hardware, software and two days of training will often disagree.

To be used effectively as a tool, the computer system must provide for all aspects of its use. It must produce better than the previous business procedures. To meet the expectations of business, the definition of a computer system should include:

- Hardware
- Software

- Maintenance
- Training
- Documentation
- Human engineering
- Contingency planning

Maintenance

The functional system entails much more than hardware and software. Without dependable maintenance, an entire office can come to a devastating standstill. Consideration must be given to repair turnaround time, inventory of a vendor's in-house parts and technical competence.

Although costs are sometimes slightly higher, purchasing the basic software and hardware package from a local source often results in preferred customer status on maintenance and ordering. For the business that is highly dependent upon its computer processing, a maintenance contract is advisable. You may arrange to buy a kit of crucial components for backup.

Training

Since maintenance is critical to continued processing, training is crucial to efficient computer use. Regardless of its potential, the computer will not improve business processing if the staff isn't well-trained. Part of the training should be conducted at the user's site to ease the adjustment to different methods and terminology. The better the training, the less employees will resist change. If your vendor has instruction available, it is advisable to supplement on-the-job training with such a course. This

helps counter any problems that may result from word-of-mouth training.

Documentation

Documentation is probably the least-liked and most ignored aspect of computer processing. But without adequate documentation, a computer system can become partly or fully obsolete long before its normal life expectancy.

For most changes you make to your system in the future, you will need the manuals provided by the hardware and software vendors. And if someone alters your system, hang on to that invoice until you are sure the change is clearly documented. If he moves and no one is sure what was done, you may have to go back to square one.

Business procedures established for computer processing must be well-documented. It serves as a ready reference for personnel, provides for problems and reruns and greatly facilitates personnel training. Thorough, current documentation of daily operations and procedures eliminates the problem of any personnel leaving with all of your established procedures in his head.

Human Engineering

The new computer normally involves a change in the methods people establish to perform their tasks. The system should be matched to its environment. The result is increased efficiency and decreased human resistance. The staff should always take part in configuring a system because, simply, they have to live with it. De-

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termine the best method for disk use and filing. Consider the keyboard height, ribbon changing, disk care and so on.

Contingency Planning

When a complete system is in place, it's time to consider the "what if" possibilities. What if a fire destroys your computer area? The statistics indicate that the loss of critical data causes a frightening percentage of businesses to close their doors. Or what if an irate employee removes all of your disk storage?

Contingency planning includes data insurance, which is at least as valuable as fire/theft insurance. The insurance company may pay for a new machine and receivables, but it cannot reproduce your data.

First, you should schedule regular backups of computer runs as frequently as you need to. Floppy disks can be corrupted, and vendor or accounting files don't re-create easily.

Second, in case of disaster, keep a copy of critical data, procedures documentation, manuals and source listings in a secure area. A fireproof, locking vault is one method, but storing this material at a different, secure location provides the best protection. And, remember, your contingency materials must be kept up-to-date.

Each potential computer user has different needs. But the above considerations are always important. The entire system must work if the user is to be satisfied.

One Approach

This approach is not the final word in consulting but, rather, an outline of the key areas potential users should consider. It is based on management-level procedures and controls analysis my company has done for larger firms.

When I'm contacted, I present a mini-tutorial to the client and find out what his requirements are. Often, he already has one or two specific packages under consideration. My tutorial includes a lay interpretation of many terms and concepts found in computer processing. Technical specifications are pretty useless if the client doesn't understand such concepts as memory, I/O and software.

I explain to the client what a complete system comprises, and offer him some criteria for selection. We then discuss some of the most important considerations: Is the system cost-effective? Is it compatible or

semistandard? Can it be expanded when the business grows? Is maintenance locally available? What is the company background of the vendor? We then order any information not in our files.

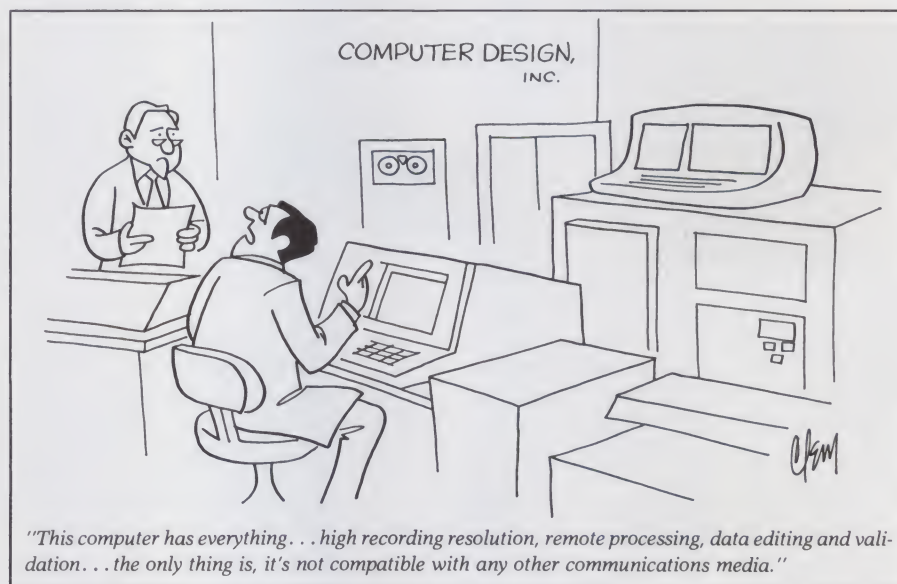
Once we've organized the information, we schedule the candidate computer vendors for demonstrations. The people who are initially responsible for the system's operation attend; they are excellent sources for feedback on a workable physical configuration, terminal and printer output quality and user functions. Once we narrow down the choices, we develop alternate configurations for the work station. The user should not dis-

ten start out with a special software package for such concerns as word processing and real estate, and evolve to where the computer is supporting all of their accounting.

Patience and education are the critical factors in the selection process. For most firms, a computer is a major investment. Better to take an extra month selecting the system than to be harassed by regret after the dollars are committed.

Installation and Training

I'm present at installation to make sure the work station is configured as planned. If the vendor offers installation, we use their experience. Other-



cover at installation time that he has no room for interface plugs.

Because a work station is a component of the system as a whole, carpentry, electrical and cabinet costs should be included in the final estimate.

A vendor's price quote usually covers hardware, software and maintenance (if available) prices. But the user needs to consider other expenses which, although more subtle, are very real. They include ac work, programming, manuals, diagnostics, disks, ribbons, print wheels, paper, accessories, training, file creation and initialization, documentation and procedures development.

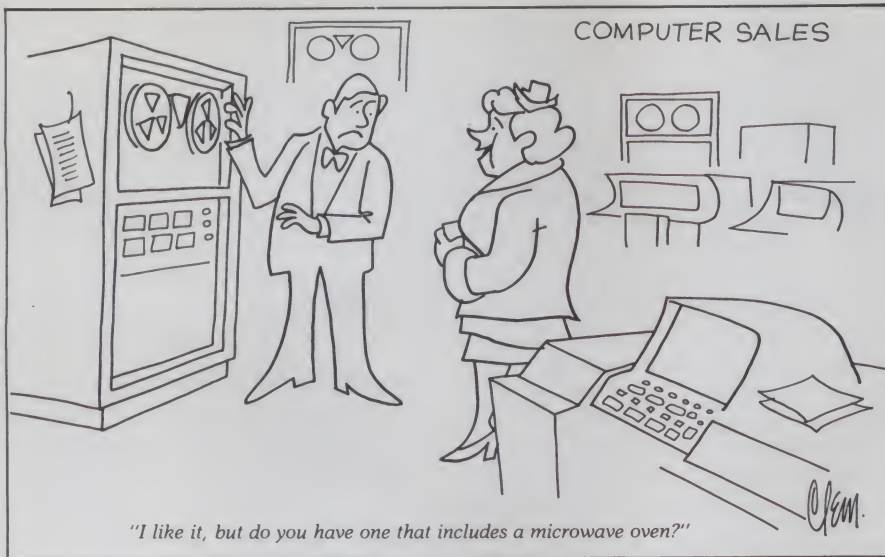
After installation, other costs arise. For instance, as the company's awareness of the computer's potential grows, so does its need for new software and peripherals. Firms of-

wise, I and a technician do it.

I don't consider the machine installed until it is functional, the software is loaded and tested, all manuals are on site and adequate supplies are available. In some cases, such as word-processing applications, my client will use the system for a period of time, and then return it to the vendor to define the most-needed user function keys.

The training process can be overwhelming for some people if they need to learn the concepts and commands in one training session. It is helpful at this stage to have technical assistance available.

While we are answering questions and clearing up misconceptions, we begin establishing processing procedures. These address time scheduling, run instructions, problem correction, file maintenance and system



care. Generally, most of the confusion that may arise at the outset is eliminated during the initialization and file creation phase.

While documentation should be outlined during the entire process, now is the time when thorough documentation is a requirement. It is often helpful to condense an operating manual into a quick-reference guide for the most-used commands, whether in a notebook or in a help file on the system. I suggest that the user keep a logbook of malfunctions, problems or repairs to provide a history of system performance. The operations procedures, if well documented, will reduce future training costs and lessen the impact of personnel turnover.

Any modifications made to a standard package must be carefully documented for future reference.

I recommend to clients that they keep the original and new listings for software and the original and new schematics for hardware. If diagnostics are available, they should be scheduled regularly.

After the Sale

After beginning normal use of your system, don't forget that conditions change and that the computer is expandable. Every six months to a year, analyze your processing. The work area may have changed, resulting in decreased efficiency. Additional development, new software, enhancements, additional terminals and so on

may now be cost-effective. Review the trouble log to spot any trends that would highlight a specific problem area. And remember: If you make changes without updating your documentation, you might do more harm than good in the future.

Conclusions

Buying your first computer system or upgrading your current system is a significant conversion. The very word "conversion" sends shivers through many data-processing managers in their third year of a two-year plan. The small-businessman or professional faces the same problems, the difference being one of scale.

Like the big shops, the key to success lies in planning, patience and adherence to procedures and controls. And, yes, in most cases there is a learning curve for your personnel that must be accounted for. After three to five days of training, a person will not normally be up to full speed and efficiency.

Be realistic about selecting and implementing a computer system. Get some nonaligned technical assistance if possible. We who are a part of the growing number of consultants must accept a professional responsibility for aiding the nontechnical person in investing company funds wisely. The enlarged concept of a system merges well with an organized business approach.

Be not discouraged! Planned carefully, the computer is an important new tool for increased efficiency and growth in your business. ■

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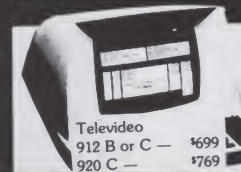
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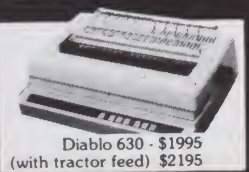
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Astrology and The Microcomputer

By J. Lee Lehman

Astrology has entered the computer age. Some 3½ percent of astrologers today own micros, and the figure is rising. Another 25 percent use either astrological computing services or their friends' micros. Companies like Astro-Graphic Services are offering increasingly sophisticated software for such computers as the Apple, PET and TRS-80.

Astrologers are finding that computers can be invaluable aids in a number of areas. They save time, make calculations easier for astrologers who have trouble with math and can pave the way for large statistical research projects. Most importantly, they free the astrologer to concentrate on chart interpretation.

How is it that astrology can be compatible with a space-age technology like computers? First, astrology is *not* the daily newspaper horoscope; we would have been better off if those had gone out with the Middle Ages. Rather, it is the study of the locations of the sun, moon, and the planets and some of the asteroids at the time of someone's—or something's—birth. An astrologer needs to know the exact birth time, and accurate calculations are critical to accurate forecasts and interpretations. The computer is an ideal means of achieving this goal.

The Basis of Astrology

The premise of astrology is that

there is a connection between planetary locations at birth and the way in which an individual's life unfolds.

Why such a connection exists is unknown, but it has been established by such writers as Dr. Michel Gauquelin. Gauquelin studied the birth charts of thousands of sports figures, physicians and scientists, soldiers, artists, actors, journalists, politicians, business executives, writers and musicians.

He found that the locations of Jupiter, Mars, Saturn and the moon were not random for those who were more successful.

The calculated probability of his results occurring by chance runs from 1 in 100 for journalists to 1 in 5 million for sports champions. When was the last time you saw a behavioral study with a chance probability of 1 in 5 million?

While Gauquelin's work does not by any means prove that astrology works, he has established that there is something to planetary effects. And that is where your friendly local astrologer comes in. Any decent professional astrologer should be able to give you a fairly detailed personality description, and tell you what's doing with your mid-life crisis, or whether you should consider changing careers, or when the investment climate is good for you.

When I do a reading for a client, I generally calculate three separate horoscopes or charts: the birth (natal)

chart and two supplemental ones which give me a handle on what the client is going through that year. These calculations could easily take several hours by hand, 45 minutes by calculator and about 20 minutes by microcomputer. When I do it on the computer, that 20 minutes gives me more information than I would have gotten via calculator, because it's just too much trouble to do some calculations routinely.

Computerization Arrives

Computerization has been creeping up on astrologers gradually. First, the ephemerides—books that list daily planetary locations—began to be calculated by computer. Then, in 1971, Neil Michelsen, then with IBM, founded Astro Computing Services (ACS). ACS, which now uses a Prime 350 minicomputer, rapidly built up a reputation for both accurate charts and fast service. They also produce ephemerides and other reference books which have become the most trustworthy in the field. An astrologer could get the three above charts calculated for about \$7.

A number of other computer services followed, with varying degrees of accuracy. (I've seen some printouts from the early period which were virtually useless.) Of comparable accuracy, and somewhat lower

Dr. J. Lee Lehman resides at 325 E. 21st St., #25, New York, NY 10010.





The author on the trail of a hot horoscope. The graphic on the screen is part of the MATRIX Software Natal Chart Program for the TRS-80. (Photo by Tee A. Corinne.)

According to Weingarten, "Fifty percent of astrologers buy computers for computers, and astrology is the extra reason, or excuse, for buying. Fifty percent are buying because they can't do the math. The ones who are not mathematically sophisticated will often buy the dedicated DR-70, or a very simple computer, 16K. The people who are into more sophisticated uses will buy more memory, a printer and disks."

The computer sophisticates are finding themselves with more options. In June 1980, AGS made their disk-based software available for the TRS-80 and Apple II. These disk programs feature better graphics and more precision, which in this case means that they are accurate for both 19th and 20th century births. (The MATRIX 16K programs lose out on the accuracy of the positions of the planets Jupiter through Pluto if you go back much earlier than 1900.)

I asked Robert Hand of AGS if he thought they were pricing themselves out of the market, since those of us who build our systems by upgrading would already have the MATRIX programs. He replied, "Our object is to allow people the option of buying computer service quality software for micros; we're just making our software available in addition to our chart calculation."

The disk-based systems promise a considerable savings in time, since quite a number of different modules

can be run off the main natal calculations. (Unfortunately, the MATRIX programs are all separate, so that the birth chart has to be recalculated along with each different kind of supplemental chart, a considerable time-waster.) Hand added that AGS will soon market astronomy programs as well, including planetary observation (angles, declinations and times) and fixed stars.

Looking Ahead

What's ahead for astrology in the computer age? Computers are certainly *not* putting astrologers out of work; if anything, they are making us work harder.

Previously, the most limiting factor in providing a reading was the amount of time one had to devote to the tedious calculations necessary to provide answers to specific questions. For instance, suppose a client is wondering whether he or she would be better off moving to a new location. By calculating one supplemental chart (that's seven minutes with good calculator technique), the astrologer can determine whether the client is likely to move during the course of the next year. If the answer is yes, then the next question is where to move to: the next town, across country, north or south?

Ideally, the astrologer calculates either a relocation chart for each city the client is considering, or at least the predominant planetary influ-

ences for each location. (Yet another facet of computerized astrology to provide a world view of the effects of location was developed by Jim Lewis. His Astro*Carto*Graphy printouts provide a map of the world and the individual's planetary strengths for all locations.) This is going to require a few minutes of time per location. It is apparent that without a computer it becomes difficult to give an immediate answer to a client during the course of a reading.

Other kinds of questions can also be answered almost immediately with the computer, provided the astrologer takes the time to write a few utility programs. I have found that since I got my computer, my readings are both more detailed and more attuned to the issues that concern the client.

Another important change of the computer age is that astrologers are now in a better position to evaluate the many methods of chart interpretation which have been kicking around. Astrology is in a transitional period; a lot of rules are still around from centuries ago. Computers are providing the means to test them on large numbers of charts.

This is especially important because most of the major astrological discoveries of the past few centuries—besides learning about the planets and asteroids discovered during this period—have consisted of finding some new calculation to answer a specific question. There are so many different techniques around that few astrologers have had the opportunity to try very many of them on more than one or two charts. As a result, it has been very difficult to sort out which techniques are generally applicable to a large number of situations. Now the limiting factor is the willingness of the astrologer to write new programs.

Computerization is making it feasible to do statistical research on a massive scale. Accordingly, the possibility of building up an astrological data base—of people who have food allergies, or club feet or whatever—is more exciting.

For the layperson, the entry of computers into astrology increases the likelihood that the birth chart is accurate. Computers are freeing the astrologer to do what he or she does best: chart interpretation.

If you want to evaluate the validity of astrology for yourself, consider shelling out the \$30–50 to your local

computerized astrologer for a reading. If you like what you hear, you just might find another use for your micro! ■

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- Astro-Graphics Services, 217 Rock Harbor Road, Orleans, MA 02653.
- Astrological Services International, 127 Madison Ave., New York, NY 10016.
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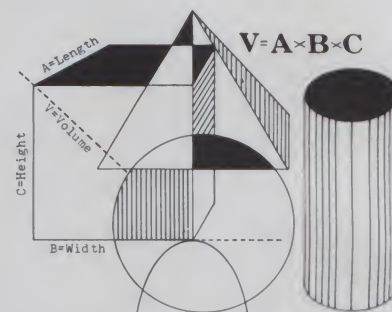
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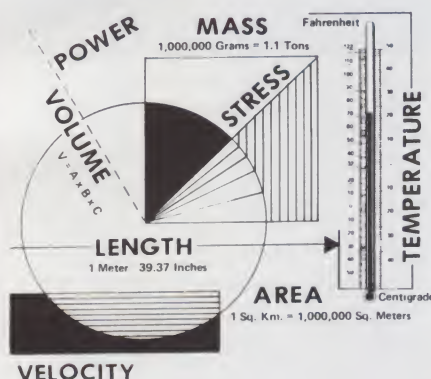
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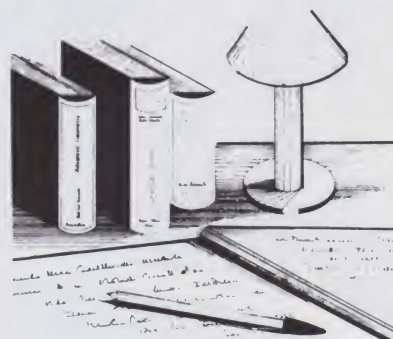
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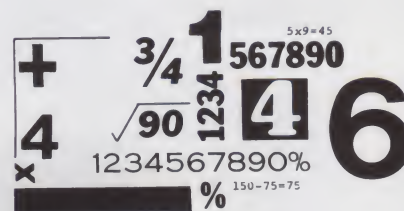
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Tracking the Planets

By E. Stanton Maxey

They said it was too complex for a microcomputer; this author proved otherwise. In MBASIC.

Demands for calculating planetary coordinates are increasing. Applications range from sighting telescopes and satellite receiving antennae dishes to the erection of astrological charts.

Elliptical orbital equations can be found in any elementary physics text, but using such equations in calculating planetary coordinates to any reasonable precision is no simple task. The complexities of multiple bodies

interacting with each other within their separate orbits is severe. One professor of astronomy and computer technology has said that the task of computing positions for only three orbiting bodies was too complex for microcomputers; that at the very least a minicomputer would be required.

I needed to determine heliocentric longitudes during research into terrestrial magnetic storms. Inquiries at the Science Museum & Planetarium of Palm Beach County, FL, led me to Dr. K. F. Pulkkinen of the U.S. Naval Observatory, Washington, DC. Dr. Pulkkinen and T. C. Van Flandern co-authored *Low Precision Formulae for Planetary Positions*. This paper provides low precision formulae for geocentric and heliocentric positions of the sun, moon and planets for any epoch within 300 years of the present. Because I required only heliocentric data, the program addresses only that requirement. Expansion for geocentric data could readily be achieved.

I used Microsoft's MBASIC program, but it can be adapted to any specific BASIC with minimal editing.

The program requires ephemeris time (equivalent to Universal time for this application), time in Julian centuries and the Julian date. The Julian date (IJD) is calculated in lines 2800-2870, Universal time (ITT) in

Program listing in Microsoft MBASIC. The program examples are for planets 0 through 8 (Mercury through Jupiter) for the test date of zero hours on June 28, 1969. The precision of result is determinable by comparing the program yield to λ values found in Table 3 of the Van Flandern and Pulkkinen paper. The heliocentric longitude of planet 2 (Earth) is the reciprocal of the Sun's longitude. The program is an operational skeleton which can be readily modified by users to meet individual requirements. The author can provide a copy on punch tape for \$25.

```
10 'This program is adapted from...
    'Low-Precision Formulae for Planetary Positions"
```

```
    by T.C Van Flandern and K.F.Pulkkinen
    US Naval Observatory, Washington
20 'The Astrophysical Journal Supplement Series,
    41:391-411,1979 November
30 '
```

```
Program written by
    E. Stanton Maxey, M.D.
    921 E. Ocean Blvd.
    Stuart, Fla. 33494
40 PRINT"This is Planet."
50 DEFDBL I,B
60 DEFINT V,A,C
70 DEFSTR P
80 DIM B(33),BA(33),BB(33),P(8,50)
90 BP2=6.283185307# 'Pi*2
100 P="###.###":P1="###":P2="###"
110 BP3=1296000# 'no. arc sec in circle
120 '
```

```
Fundamental Arguments
130 BA(7)=.779072# :BB(7)=.00273790931# 'Ls
140 BA(8)=VAL(".993126") :BB(8)=.0027377785# 'Gs
150 BA(9)=.700695# :BB(9)=.011367714# 'L1
160 BA(10)=.485541# :BB(10)=.01136759566# 'G1
170 BA(11)=.566441# :BB(11)=.01136762384# 'F1
180 BA(12)=VAL(".505498") :BB(12)=VAL(".00445046867") 'L2
190 BA(13)=.140023# :BB(13)=.00445036173# 'G2
200 BA(14)=.292498# :BB(14)=.00445040017# 'F2
210 BA(15)=VAL(".987353") :BB(15)=.00145575328# 'L4
220 BA(16)=VAL(".053856") :BB(16)=.00145561327# 'G4
230 BA(17)=VAL(".849694") :BB(17)=.00145569465# 'F4
240 BA(18)=.089608# :BB(18)=.00023080893# 'L5
250 BA(19)=VAL(".056531") :BB(19)=BB(18) 'G5
260 BA(20)=VAL(".814794") :BB(20)=BB(18) 'F5
270 BA(21)=.133295# :BB(21)=.00009294371# 'L6
```

More

Dr. E. Stanton Maxey is with the Ocean Boulevard Medical Center, 921 East Ocean Blvd., Stuart, FL 33494.

line 2880 and time in Julian centuries (IT) in line 2890. (IT) is the only polynomial variable needed for the program.

Line 2920 calculates values for the fundamental arguments using Universal time (ITT) and the arguments defined in lines 130-380. These arguments are taken directly from the Pulkkinen paper. Note that val ('.821218') is used instead of (.821218#), since the B variable is defined as double precision and MBASIC likes to print these values in 16 digits. The val function saves some memory here.

The expression for heliocentric longitude—B(V)—is calculated in lines 2920-2930 and lines 3080-3280. For example, the first four terms of the series for the longitude of Jupiter are computed as follows:

```
B(V)—.089608+.00023080893·ITT=
19934·sin(.056531+.00023080893·ITT)
+5023·IT
+2511
+1093·COS(2·(.056531+.00023080893
×ITT)—5·(.0882987+.00009294371·
ITT)).
```

Arcseconds are converted to radians in line 3120. String arrays are extensively employed, since their characteristics allow incorporation of the PLON (periodic terms) in an easily accessible format. The zero string, e.g., P(8,0)='3222' in line 2570, conveys the numbers of the fundamental arguments; in this case argument 32 is found in line 370 and argument 33 in line 380. The lengths of variables P(0,0) through P(8,0) enable dynamic computation (in lines 3100-3130), depending on the number of fundamental arguments used.

Lines 3320-3390 convert arcseconds to degrees, minutes and seconds, which are then printed out as such. I consistently got precision of less than 1 minute of arc as checked by the American Ephemeris and Nautical Almanac. The exception was Pluto, which was up to 5 minutes of arc in error. This is understandable, since Van Flandern and Pulkkinen claim only 15 minutes precision for Pluto.

The program as written will require 13,700 bytes of memory after BASIC is loaded. Users short of memory can separate the program into two portions and store all string PLON arrays in magnetic memory with a shorter first program. The string variables can then be loaded from disk or cassette as part of a much shorter operating second program. ■

Listing continued.

```
280 BA(22)=.882987#;BB(22)=BB(21)'G6
290 BA(23)=VAL(".821218");BB(23)=BB(21)'F6
300 BA(24)=VAL(".870169");BB(24)=VAL(".00003269438")'L7
310 BA(25)=.400589#;BB(25)=BB(24)'G7
320 BA(26)=VAL(".664614");BB(26)=.00003265562#'F7
330 BA(27)=.846912#;BB(27)=.00001672092#'L8
340 BA(28)=VAL(".725368");BB(28)=BB(27)'G8
350 BA(29)=.480856#;BB(29)=.00001663715#'F8
360 BA(31)=VAL(".663854");BB(31)=.0000115482#'L9
370 BA(32)=.04102#;BB(32)=.00001104864#'G9
380 BA(33)=.357355#;BB(33)=BB(32)
390 P(0,0)="101113"each 2 digits=no. of fundamental argument
400 '
```

PLON coefficients

```
410 'length of string gives total arguments used
420 '+/- allows string splitting and evaluation
430 '
```

Mercury

```
440 P(0,1)="84378 0S+ 1+ 0+ 0"
450 P(0,2)="10733 0S+ 2+ 0+ 0"
460 P(0,3)="1892 0S+ 3+ 0+ 0"
470 P(0,4)="-646 0S+ 0+ 2+ 0"
480 P(0,5)="381 0S+ 4+ 0+ 0"
490 P(0,6)="-306 0S+ 1- 2+ 0"
500 P(0,7)="-274 0S+ 1+ 2+ 0"
510 P(0,8)="-92 0S+ 2+ 2+ 0"
520 P(0,9)="83 0S+ 5+ 0+ 0"
530 P(0,10)="-28 0S+ 3+ 2+ 0"
540 P(0,11)="25 0S+ 2- 2+ 0"
550 P(0,12)="19 0S+ 6+ 0+ 0"
560 P(0,13)="-9 0S+ 4+ 2+ 0"
570 P(0,14)="8 1S+ 1+ 0+ 0"
580 P(0,15)="7 0C+ 2+ 0- 5"
590 '
```

Venus

```
600 P(1,0)="081314"
610 P(1,1)="2814 0S+ 0+ 1+ 0"
620 P(1,2)="-181 0S+ 0+ 0+ 2"
630 P(1,3)="-20 1S+ 0+ 1+ 0"
640 P(1,4)="12 0S+ 0+ 2+ 0"
650 P(1,5)="-10 0C+ 2- 2+ 0"
660 P(1,6)="7 0C+ 3- 3+ 0"
670 '
```

Earth

```
680 P(2,0)="010708131619"
690 P(2,1)="6910 0S+ 0+ 0+ 1+ 0+ 0"
700 P(2,2)="72 0S+ 0+ 0+ 2+ 0+ 0"
710 P(2,3)="-17 1S+ 0+ 0+ 1+ 0+ 0"
720 P(2,4)="-7 0C+ 0+ 0+ 1+ 0+ 0- 1"
730 P(2,5)="6 0S+ 1- 1+ 0+ 0+ 0"
740 P(2,6)="5 0S+ 0+ 0+ 4+ 0- 8+ 3"
750 P(2,7)="-5 0C+ 0+ 0+ 2- 2+ 0+ 0"
760 P(2,8)="-4 0S+ 0+ 0+ 1- 1+ 0+ 0"
770 P(2,9)="4 0C+ 0+ 0+ 4+ 0- 8+ 3"
780 P(2,10)="3 0S+ 0+ 0+ 2- 2+ 0+ 0"
790 P(2,11)="-3 0S+ 0+ 0+ 0+ 0+ 0+ 1"
800 P(2,12)="-3 0S+ 0+ 0+ 2+ 0+ 0- 2"
810 '
```

Mars

```
820 P(3,0)="0813161719"
830 P(3,1)="38451 0S+ 0+ 0+ 1+ 0+ 0"
840 P(3,2)="2238 0S+ 0+ 0+ 2+ 0+ 0"
850 P(3,3)="181 0S+ 0+ 0+ 3+ 0+ 0"
860 P(3,4)="-52 0S+ 0+ 0+ 0+ 2+ 0"
870 P(3,5)="37 1S+ 0+ 0+ 1+ 0+ 0"
880 P(3,6)="-22 0C+ 0+ 0+ 1+ 0- 2"
890 P(3,7)="-19 0S+ 0+ 0+ 1+ 0- 1"
900 P(3,8)="17 0C+ 0+ 0+ 1+ 0- 1"
910 P(3,9)="17 0S+ 0+ 0+ 4+ 0+ 0"
920 P(3,10)="-16 0C+ 0+ 0+ 2+ 0- 2"
930 P(3,11)="13 0C+ 1+ 0- 2+ 0+ 0"
940 P(3,12)="-10 0S+ 0+ 0+ 1- 2+ 0"
950 P(3,13)="-10 0S+ 0+ 0+ 1+ 2+ 0"
960 P(3,14)="7 0C+ 1+ 0- 1+ 0+ 0"
970 P(3,15)="-7 0C+ 2+ 0- 3+ 0+ 0"
980 P(3,16)="-5 0S+ 0+ 1- 3+ 0+ 0"
990 P(3,17)="-5 0S+ 1+ 0- 1+ 0+ 0"
1000 P(3,18)="-5 0S+ 1+ 0- 2+ 0+ 0"
1010 P(3,19)="-4 0C+ 2+ 0- 4+ 0+ 0"
1020 P(3,20)="4 1S+ 0+ 0+ 2+ 0+ 0"
1030 P(3,21)="4 0C+ 0+ 0+ 0+ 0+ 1"
1040 P(3,22)="3 0C+ 0+ 1- 3+ 0+ 0"
1050 P(3,23)="3 0S+ 0+ 0+ 2+ 0- 2"
1060 '
```

Jupiter

```
1070 P(4,0)="18192225"
1080 P(4,1)="19934 0S+ 0+ 1+ 0+ 0"
1090 P(4,2)="5023 1C+ 0+ 0+ 0+ 0"
1100 P(4,3)="2511 0C+ 0+ 0+ 0+ 0"
1110 P(4,4)="1093 0C+ 0+ 2- 5+ 0"
```

More

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Introducing SIMUTEK'S ZBASIC. The truly interactive BASIC COMPILER for your TRS-80! FINALLY! People that don't have the time or the inclination to learn complicated assembly language, have a chance to write PROFESSIONAL QUALITY SOFTWARE in machine language using a subset of LEVEL II BASIC!!

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ZBASIC allows saving your COMPILED PROGRAM as a system tape, (tape version), or as /CMD file, (disk version). THE COMPILED CODE IS VERY EFFICIENT Z80 OBJECT CODE. THE LEVEL II ROMS ARE USED ONLY FOR I/O ROUTINES!!

FACTS ABOUT ZBASIC

- 16K ZBASIC will compile a 4.8K program. (tape only)
- 32K ZBASIC will compile a 17K (tape), 10K (disk) pgm.
- 48K ZBASIC will compile a 17K program. (disk only)
- (These are approximate values depending on program efficiency etc.)
- ZBASIC DOES NOT support disk or tape files.
- BASIC programs compiled with ZBASIC are between 10-200 times faster than interpreted BASIC!!
- NO ROYALTIES ON ZBASIC COMPILED PROGRAMS!!
- ZBASIC programs are only about 1.1 times larger than the average basic program
- ZBASIC programs may be used as USR routines from basic.
- ZBASIC uses INTEGER MATH ONLY to increase speed and decrease compiled program size. Use of Single or Double precision would destroy the beauty of the first "INTERACTIVE COMPILER" on the market!
- Limited variables: A-Z, A1-Z1, A2-Z2, A\$-Z\$. Arrays are not supported to decrease memory demands and speed up compiling of programs.
- COMPILE TIMES ARE TYPICALLY 1 TO 10 SECONDS! THERE IS NO NEED TO USE COMPLICATED COMPILE TIME MODULES!
- ZBASIC comes with a HIGHLY DETAILED manual describing all important memory locations, commands, variables, warm/cold start entry points and many useful sub-routines for emulating unsupported commands!!
- Existing programs may be loaded from tape or disk and compiled as long as unsupported commands or variables are not used.

ALL COMMANDS DIRECTLY SUPPORTED BY ZBASIC

FOR	NEXT	STEP	IF	THEN	ELSE	PEEK
SET	RESET	POINT	CHRS	RANDOM	RND	POKE
DATA	READ	RESTORE	END	GOTO	GOSUB	CLS
INPUT	INKEY\$	LET	STOP	OUT	INP	RETURN
PRINT	LPRINT	PRINT@	USR	SGN	INT	ABS
SQR	LEN	ASC	VAL	STR\$	POS	ON GOTO
ON GOSUB	REM	NOT	AND	OR		

INTEGER MATH *MULTIPLY /DIVIDE +ADD -SUBTRACT ^-32767

NOTE: Some commands do not act exactly as BASIC commands act

TRS-80 MOD I and III or PMC-80 Computers. (Level II Only) NEW LOWER PRICES!

ZBASIC 16K/32K LVII Tape Version + Manual	\$79.95
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Model III Version Available 3/1/81	

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COMPUTER PRODUCTS™**

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(C.O.D. Available \$3.00 Extra)
TRS-80 is a TM of Tandy Corp

Listing continued.

```

1120 P(4,5)=-601 0S+ 0+ 2+ 0+ 0"
1130 P(4,6)=-479 0S+ 0+ 2- 5+ 0"
1140 P(4,7)=-185 0S+ 0+ 2- 2+ 0"
1150 P(4,8)=-137 0S+ 0+ 3- 5+ 0"
1160 P(4,9)=-131 0S+ 0+ 1- 2+ 0"
1170 P(4,10)=-79 0C+ 0+ 1- 1+ 0"
1180 P(4,11)=-76 0C+ 0+ 2- 2+ 0"
1190 P(4,12)=-74 1C+ 0+ 1+ 0+ 0"
1200 P(4,13)=-68 1S+ 0+ 1+ 0+ 0"
1210 P(4,14)=-66 0C+ 0+ 2- 3+ 0"
1220 P(4,15)=-63 0C+ 0+ 3- 5+ 0"
1230 P(4,16)=-53 0C+ 0+ 1- 5+ 0"
1240 P(4,17)=-49 0S+ 0+ 2- 3+ 0"
1250 P(4,18)=-43 1S+ 0+ 2- 5+ 0"
1260 P(4,19)=-37 0C+ 0+ 1+ 0+ 0"
1270 P(4,20)=-25 0S+ 2+ 0+ 0+ 0"
1280 P(4,21)=-25 0S+ 0+ 3+ 0+ 0"
1290 P(4,22)=-23 0S+ 0+ 1- 5+ 0"
1300 P(4,23)=-19 1C+ 0+ 2- 5+ 0"
1310 P(4,24)=-17 0C+ 0+ 2- 4+ 0"
1320 P(4,25)=-17 0C+ 0+ 3- 3+ 0"
1330 P(4,26)=-14 0S+ 0+ 1- 1+ 0"
1340 P(4,27)=-13 0S+ 0+ 3- 4+ 0"
1350 P(4,28)=-9 0C+ 2+ 0+ 0+ 0"
1360 P(4,29)=-9 0C+ 0+ 0+ 1+ 0"
1370 P(4,30)=-9 0S+ 0+ 0+ 1+ 0"
1380 P(4,31)=-9 0S+ 0+ 3- 2+ 0"
1390 P(4,32)=-9 0S+ 0+ 4- 5+ 0"
1400 P(4,33)=-9 0S+ 0+ 2- 6+ 3"
1410 P(4,34)=-8 0C+ 0+ 4-10+ 0"
1420 P(4,35)=-7 0C+ 0+ 3- 4+ 0"
1430 P(4,36)=-7 0C+ 0+ 1- 3+ 0"
1440 P(4,37)=-7 0S+ 0+ 4-10+ 0"
1450 P(4,38)=-7 0S+ 0+ 1- 3+ 0"
1460 P(4,39)=-6 0C+ 0+ 4- 5+ 0"
1470 P(4,40)=-6 0S+ 0+ 3- 3+ 0"
1480 '

```

Saturn

```

1490 P(5,0)=-19212225"
1500 P(5,1)=-23045 0S+ 0+ 0+ 1+ 0"
1510 P(5,2)=-5014 1C+ 0+ 0+ 0+ 0"
1520 P(5,3)=-2689 0C+ 2+ 0- 5+ 0"
1530 P(5,4)=-2507 0C+ 0+ 0+ 0+ 0"
1540 P(5,5)=-1177 0S+ 2+ 0- 5+ 0"
1550 P(5,6)=-826 0C+ 2+ 0- 4+ 0"
1560 P(5,7)=-802 0S+ 0+ 0+ 2+ 0"
1570 P(5,8)=-425 0S+ 1+ 0- 2+ 0"
1580 P(5,9)=-229 1C+ 0+ 0+ 1+ 0"
1590 P(5,10)=-153 0C+ 2+ 0- 6+ 0"
1600 P(5,11)=-142 1S+ 0+ 0+ 1+ 0"
1610 P(5,12)=-114 0C+ 0+ 0+ 1+ 0"
1620 P(5,13)=-101 1S+ 2+ 0- 5+ 0"
1630 P(5,14)=-70 0C+ 0+ 2+ 0+ 0"
1640 P(5,15)=-67 0S+ 0+ 2+ 0+ 0"
1650 P(5,16)=-66 0S+ 2+ 0- 6+ 0"
1660 P(5,17)=-60 1C+ 2+ 0- 5+ 0"
1670 P(5,18)=-41 0S+ 1+ 0- 3+ 0"
1680 P(5,19)=-39 0S+ 0+ 0+ 3+ 0"
1690 P(5,20)=-31 0S+ 1+ 0- 1+ 0"
1700 P(5,21)=-31 0S+ 2+ 0- 2+ 0"
1710 P(5,22)=-29 0C+ 2+ 0- 3+ 0"
1720 P(5,23)=-28 0S+ 2+ 0- 6+ 3"
1730 P(5,24)=-28 0C+ 1+ 0- 3+ 0"
1740 P(5,25)=-22 1S+ 2+ 0- 4+ 0"
1750 P(5,26)=-22 0S+ 2+ 0+ 1- 3"
1760 P(5,27)=-20 0S+ 2+ 0- 3+ 0"
1770 P(5,28)=-20 0C+ 4+ 0-10+ 0"
1780 P(5,29)=-19 0C+ 0+ 0+ 2- 3"
1790 P(5,30)=-19 0S+ 4+ 0-10+ 0"
1800 P(5,31)=-17 1C+ 0+ 0+ 2+ 0"
1810 P(5,32)=-16 0C+ 0+ 0+ 1- 3"
1820 P(5,33)=-12 0S+ 2+ 0- 4+ 0"
1830 P(5,34)=-12 0C+ 1+ 0+ 0+ 0"
1840 P(5,35)=-12 0S+ 0+ 0+ 2- 2"
1850 P(5,36)=-11 1S+ 0+ 0+ 2+ 0"
1860 P(5,37)=-11 0C+ 2+ 0- 7+ 0"
1870 P(5,38)=-10 0S+ 0+ 0+ 2- 3"
1880 P(5,39)=-10 0C+ 2+ 0- 2+ 0"
1890 P(5,40)=-9 0S+ 4+ 0- 9+ 0"
1900 P(5,41)=-8 0S+ 0+ 0+ 1- 2"
1910 P(5,42)=-8 0C+ 0+ 2+ 1+ 0"
1920 P(5,43)=-8 0C+ 0+ 2- 1+ 0"
1930 P(5,44)=-8 0C+ 0+ 0+ 1- 1"
1940 P(5,45)=-8 0S+ 0+ 2- 1+ 0"
1950 P(5,46)=-7 0S+ 0+ 2+ 1+ 0"
1960 P(5,47)=-7 0C+ 1+ 0- 2+ 0"
1970 P(5,48)=-7 0C+ 0+ 0+ 2+ 0"
1980 P(5,49)=-6 1S+ 4+ 0-10+ 0"
1990 P(5,50)=-6 1C+ 4+ 0-10+ 0"
2000 '

```

Uranus

```

2010 P(6,0)=-1922252628"
2020 P(6,1)=-19397 0S+ 0+ 0+ 1+ 0+ 0"
2030 P(6,2)=-570 0S+ 0+ 0+ 2+ 0+ 0"

```

More

Listing continued.

```

2040 P(6,3)="-536 1C+ 0+ 0+ 1+ 0+ 0"
2050 P(6,4)="-143 0S+ 0+ 1- 2+ 0+ 0"
2060 P(6,5)="-110 1S+ 0+ 0+ 1+ 0+ 0"
2070 P(6,6)="-102 0S+ 0+ 1- 3+ 0+ 0"
2080 P(6,7)="-76 0C+ 0+ 1- 3+ 0+ 0"
2090 P(6,8)="-49 0S+ 1+ 0- 1+ 0+ 0"
2100 P(6,9)="-32 2C+ 0+ 0+ 0+ 0+ 0"
2110 P(6,10)="-30 1C+ 0+ 0+ 2+ 0+ 0"
2120 P(6,11)="-29 0S+ 2- 6+ 3+ 0+ 0"
2130 P(6,12)="-29 0C+ 0+ 0+ 2+ 0- 2"
2140 P(6,13)="-28 0C+ 0+ 0+ 1+ 0- 1"
2150 P(6,14)="-23 0S+ 0+ 0+ 3+ 0+ 0"
2160 P(6,15)="-21 0C+ 1+ 0- 1+ 0+ 0"
2170 P(6,16)="-20 0S+ 0+ 0+ 1+ 0- 1"
2180 P(6,17)="-20 0C+ 0+ 1- 2+ 0+ 0"
2190 P(6,18)="-19 0C+ 0+ 1- 1+ 0+ 0"
2200 P(6,19)="-17 0S+ 0+ 0+ 2+ 0- 3"
2210 P(6,20)="-14 0S+ 0+ 0+ 3+ 0- 3"
2220 P(6,21)="-13 0S+ 0+ 1- 1+ 0+ 0"
2230 P(6,22)="-12 2C+ 0+ 0+ 1+ 0+ 0"
2240 P(6,23)="-12 0C+ 0+ 0+ 1+ 0+ 0"
2250 P(6,24)="-10 0S+ 0+ 0+ 2+ 0- 2"
2260 P(6,25)="-9 0S+ 0+ 0+ 0+ 2+ 0"
2270 P(6,26)="-9 2S+ 0+ 0+ 1+ 0+ 0"
2280 P(6,27)="-9 0C+ 0+ 0+ 2+ 0- 3"
2290 P(6,28)="-8 1C+ 0+ 1- 2+ 0+ 0"
2300 P(6,29)="-7 1C+ 0+ 1- 3+ 0+ 0"
2310 P(6,30)="-7 1S+ 0+ 1- 3+ 0+ 0"
2320 P(6,31)="-7 1S+ 0+ 0+ 2+ 0+ 0"
2330 P(6,32)="-6 0S+ 2- 6+ 2+ 0+ 0"
2340 P(6,33)="-6 0C+ 2- 6+ 2+ 0+ 0"
2350 P(6,34)="-5 0S+ 0+ 1- 4+ 0+ 0"
2360 P(6,35)="-4 0S+ 0+ 0+ 3+ 0- 4"
2370 P(6,36)="-4 0C+ 0+ 0+ 3+ 0- 3"
2380 P(6,37)="-3 0C+ 0+ 0+ 0+ 0+ 1"
2390 P(6,38)="-2 0S+ 0+ 0+ 0+ 0+ 1"
2400 '

```

Neptune

```

2410 P(7,0)="-1922252829"
2420 P(7,1)="-3523 0S+ 0+ 0+ 1+ 0"
2430 P(7,2)="-50 0S+ 0+ 0+ 0+ 2"
2440 P(7,3)="-43 1C+ 0+ 0+ 0+ 1+ 0"
2450 P(7,4)="-29 0S+ 1+ 0+ 0- 1+ 0"
2460 P(7,5)="-19 0S+ 0+ 0+ 0+ 2+ 0"
2470 P(7,6)="-18 0C+ 1+ 0+ 0- 1+ 0"
2480 P(7,7)="-13 0C+ 0+ 1+ 0- 1+ 0"
2490 P(7,8)="-13 0S+ 0+ 1+ 0- 1+ 0"
2500 P(7,9)="-9 0S+ 0+ 0+ 2- 3+ 0"
2510 P(7,10)="-9 0C+ 0+ 0+ 2- 2+ 0"
2520 P(7,11)="-5 0C+ 0+ 0+ 2- 3+ 0"
2530 P(7,12)="-4 1S+ 0+ 0+ 0+ 1+ 0"
2540 P(7,13)="-4 0C+ 0+ 0+ 1- 2+ 0"
2550 P(7,14)="-4 2S+ 0+ 0+ 0+ 1+ 0"
2560 '

```

Pluto

```

2570 P(8,0)="-3233"
2580 P(8,1)="-101577 0S+ 1+ 0"
2590 P(8,2)="-15517 0S+ 2+ 0"
2600 P(8,3)="-3593 0S+ 0+ 2"
2610 P(8,4)="-3414 0S+ 3+ 0"
2620 P(8,5)="-2201 0S+ 1- 2"
2630 P(8,6)="-1871 0S+ 1+ 2"
2640 P(8,7)="-839 0S+ 4+ 0"
2650 P(8,8)="-757 0S+ 2+ 2"
2660 P(8,9)="-285 0S+ 3+ 2"
2670 P(8,10)="-227 2S+ 1+ 0"
2680 P(8,11)="-218 0S+ 2- 2"
2690 P(8,12)="-200 1S+ 1+ 0"
2700 '

```

Problem Insertion

```

2710 PRINT"Insert Problem"
2720 PRINT"Planets are sequentially numbered."
2730 PRINT" Mercury = 0."
2740 PRINT" Venus = 1."
2750 PRINT" Pluto = 8."
2760 PRINT"Number >8 = End.":PRINT""
2770 INPUT"Planet Number";A
2780 IF A>8 THEN END
2790 '

```

Convert Gregorian calendar to Julian Date.

```

2800 INPUT"Month";IM
2810 INPUT"Day";ID
2820 INPUT"Year";IY
2830 IJD=367*IY
2840 IJD=IJD-FIX(7*(IY+FIX((IM+9)/12))/4)
2850 IJD=IJD-FIX(3*(FIX((IY+FIX((IM-9)/7))/100)+1)/4)
2860 IJD=IJD+FIX(275*IM/9)+ID+1721029#
2870 IJD=IJD-.5#half day diff in standard
2880 ITT=IJD-2451545#ITT=t
2890 IT=ITT/36525#1#IT=Time in Julian Centuries
2900 GOTO 2950
2910 'B(7-33)=Fundamental Arguments in dbl precision

```

(More)

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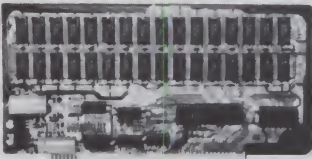
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Listing continued.

```
2920 B(V)=BA(V)+BB(V)*ITT
2930 B(V)=B(V)-FIX(B(V))'Get part of revolution
2940 RETURN
2950 '
```

A=No. of planet being processed

```
2960 ON A+1 GOTO 2970,3000,3010,3020,3030,3040,3050,3060,3070
2970 V=9:V1=15:GOTO 3080'Mercury
2980 'V=No. of 'L' argument
2990 'V1=No. iterations for individual planet
3000 V=12:V1=6:GOTO 3080'Venus
3010 V=7:V1=12:GOTO 3080'Earth reciprocal of Sun
3020 V=15:V1=23:GOTO 3080'Mars
3030 V=18:V1=40:GOTO 3080'Jupiter
3040 V=21:V1=50:GOTO 3080'Saturn
3050 V=24:V1=38:GOTO 3080'Uranus
3060 V=27:V1=14:GOTO 3080'Neptune
3070 V=31:V1=12:GOTO 3080'Pluto
3080 GOSUB 2920
3090 BL(A)=B(V)*BP3'L in arc secs
3100 FOR C=1 TO LEN(P(A,0)) STEP 2
3110 '
```

calculate Plon Trig Arguments

```
3120 V=VAL(MIDS(P(A,0),C,2)):GOSUB 2920:B(V)=B(V)*BP2'b(v) in radians
3130 NEXT C
3140 BG(A)=BL(A)'bq(a)=lambda
3150 FOR V=1 TO V1'V1=No. of iterations
3160 V2=INSTR(P(A,V),"")-1
3170 BCO=VAL(LEFT$(P(A,V),V2))'BCO=Coefficient peeled off data string
3180 ITF=VAL(MIDS(P(A,V),V2+2,1))'ITF='T' factor peeled out of data string
3190 IF ITF<>0 THEN BCO=BCO*IT*ITF'Multiply by T factor if >0
3200 FOR V3=1 TO LEN(P(A,0))/2
3210 BV=VAL(MIDS(P(A,0),2*V3-1,2))
3220 BT=BT+VAL(MIDS(P(A,V),V2+1+3*V3,3))*B(BV)
3230 NEXT V3
3240 '
```

Do either sine or cosine

```
3250 IF MIDS(P(A,V),V2+3,1)="C" THEN 3270
3260 BG(A)=BG(A)+BCO*SIN(BT):GOTO 3280
3270 BG(A)=BG(A)+BCO*COS(BT)
3280 BT=0:NEXT V
3290 IF A=2 THEN BG(A)=BG(A)+648000#'
```

recip of Sun for Earth

```
3300 IF BG(A)>BP3 THEN BG(A)=BG(A)-BP3
3310 IF BG(A)<0 THEN BG(A)=BG(A)+BP3:GOTO 3310
3320 PRINT"Lambda="BG(A)"Arc Sec"
3330 BM=FIX(BG(A)/60#)
3340 BS=BG(A)-BM*60#
3350 BD=FIX(BM/60#)
3360 BM=BM-BD*60#:IF BD=-1 AND BM=60 THEN BD=0:BM=0
3370 PRINT USING P2;BD;:PRINT" ";
3380 PRINT USING P1;BM;:PRINT" ";
3390 PRINT USING P;BS;:PRINT CHR$(34)
3400 PRINT"":PRINT"Insert New Problem"
3410 GOTO 2720
```

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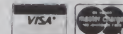
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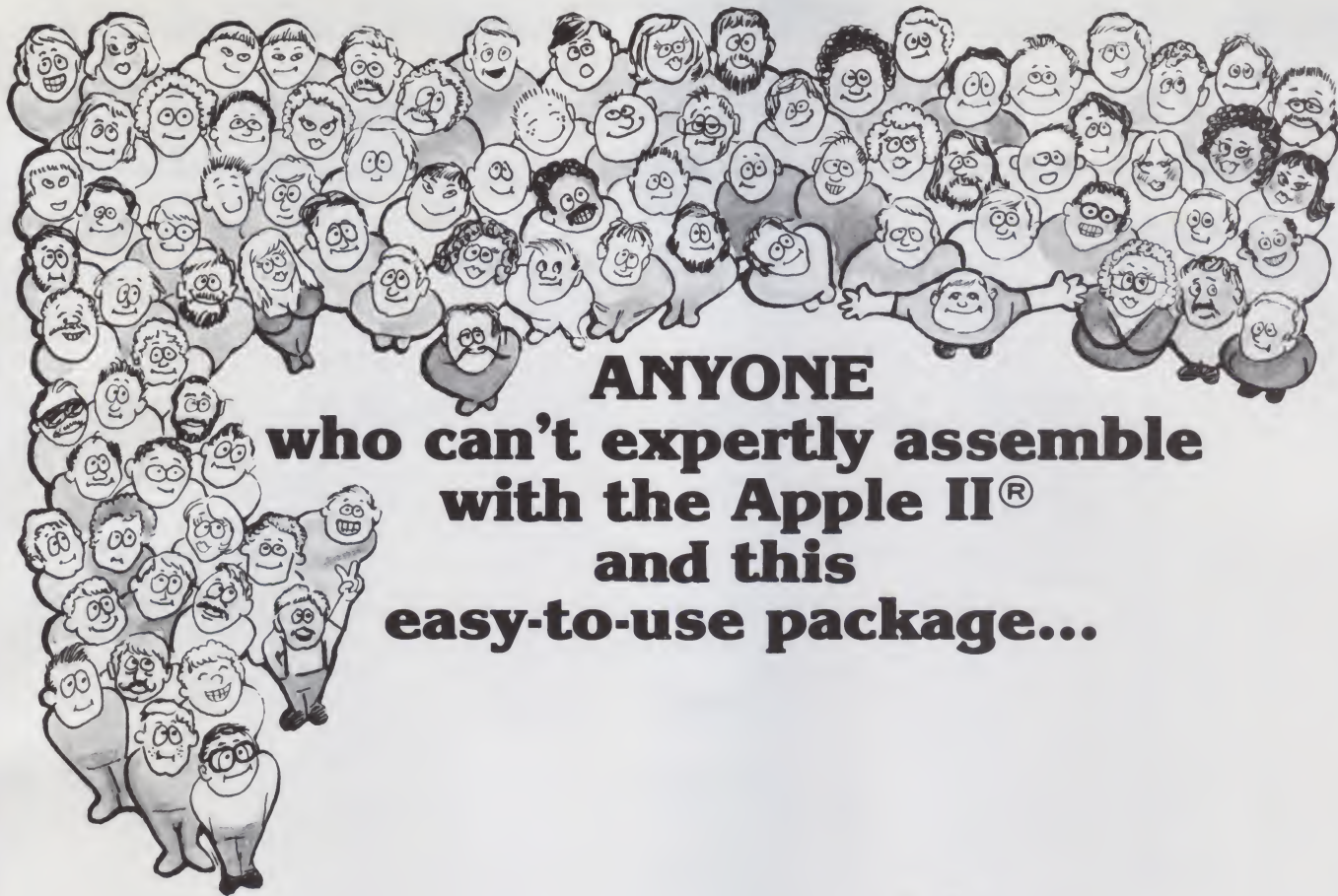
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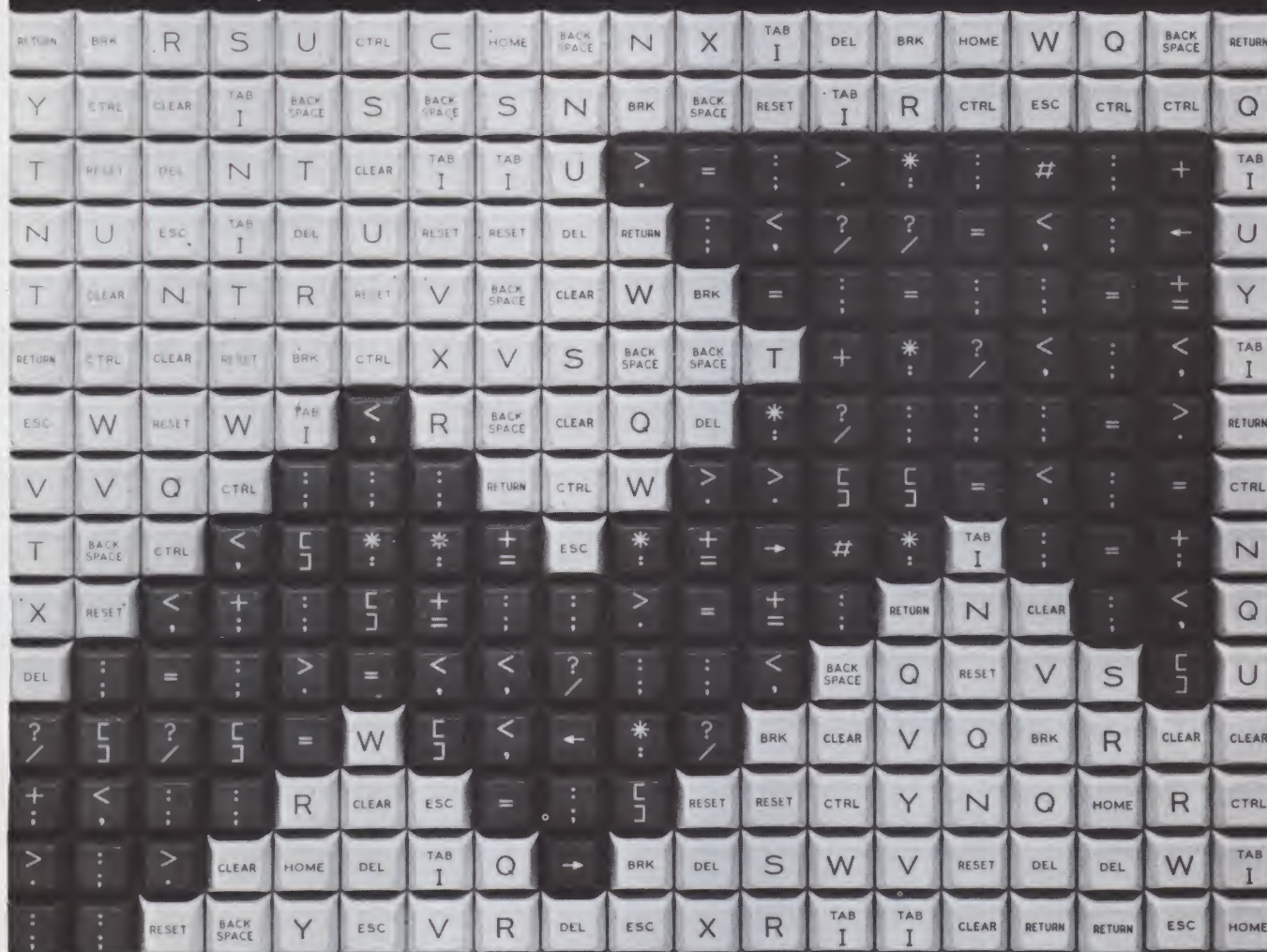
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MAT Functions

By B. Antony Paturzo

Arrays come in handy when handling large amounts of data, especially data that can be easily tabulated. So, it's not surprising to find arrays used in a large variety of programs, from engineering to business.

What is surprising, and unfortunate, is that the BASICs available for a large number of micros do not have MAT functions, which are the BASIC array manipulators. Without these functions, the user must either oper-

ate on elements of an array one by one, or write his own MAT functions.

First, an array is a collection of items, which can be anything from profit percentages to resistor values. A one-dimensional array is called a *list* of items, or in mathematical terms, a *vector*. A two-dimensional array is called a *table*, or matrix. Since vectors and matrices both describe arrays, you can think of a vector as a special kind of matrix.

Keeping the above definitions in mind, the following example programs are intended for those using a BASIC without MAT functions.

FOR-NEXT Loops

Most of the MAT functions can be implemented using FOR-NEXT loops. Listing 1 shows how a MAT READ operation can be done. RA and CA refer to row and column, respectively, and are defined by the calling program. The DATA statements, contained elsewhere, can be written so that an RA number of DATA statements each contain a CA number of elements.

A variation of the read subroutine permits user input of the matrix elements. Listing 2 shows how you can input the matrix elements individually, a process obviously slower than using DATA statements.

A MAT PRINT is nearly identical to the MAT READ subroutine, with the replacement of READ with PRINT in line 1040. Rather than duplicate the read subroutine for MAT PRINT, Listing 3 shows how you can combine the two operations using W (for write) as the calling program selector

of either a read or print operation.

The subroutine for a MAT ADD/-SUBTRACT is shown in Listing 4, with S (for subtract) being the calling program's selection of either an add or subtract operation. The result is stored in matrix D. Note that for these two operations, matrix A must contain the same number of rows as matrix B, as well as the same number of columns as B.

Matrix multiplication is not as straightforward as addition or subtraction. This type of multiplication consists of a *row-on-column* multiplication sequence. Therefore, matrix A's number of columns must equal matrix B's number of rows. The result of the multiplication, matrix D, will be a matrix with the same number of rows as matrix A and the same number of columns as matrix B. Two cases are illustrated in Listing 5, the first where B is a vector (or one-dimensional), and the second where B is two-dimensional.

The remaining MAT functions are MAT ZER, MAT CON, MAT IDN, MAT TRN and MAT INV, and the DET function, which finds the determinant of a *square* matrix. MAT ZER and MAT CON are relatively simple operations; the former assigns all 0s to a matrix, while the latter assigns all 1s to a matrix. MAT ZER can be accomplished by replacing line 1040 of Listing 1 with "A(I,J)=0," while MAT CON replaces line 1040 with "A(I,J)=1."

MAT IDN creates an identity ma-

```
1000 REM MAT READ
1010 DIM A(RA,CA)
1020 FOR I=1 TO RA
1030 FOR J=1 TO CA
1040 READ A(I,J)
1050 NEXT J
1060 NEXT I
1070 RETURN
```

Listing 1.

```
1080 REM MAT INPUT
1090 DIM A(RA,CA)
1100 FOR I=1 TO RA
1110 PRINT "ROW ";I
1120 FOR J=1 TO CA
1130 PRINT "COLUMN ";J
1140 INPUT A(I,J)
1150 NEXT J
1160 NEXT I
1170 RETURN
```

Listing 2.

Address correspondence to B. Antony Paturzo, 1929 Trudie Drive, San Pedro, CA 90732.


```

1180 REM MAT READ/PRINT
1190 REM IF W(WRITE)=1, PRINT
1200 DIM A(RA,CA)
1210 FOR I=1 TO RA
1220 FOR J=1 TO CA
1230 IF W=1 THEN PRINT A(I,J):GOTO 1250
1240 READ A(I,J)
1250 NEXT J
1260 NEXT I
1270 RETURN

```

Listing 3.

```

1380 REM MAT MULT, B IS A VECTOR
1390 REM SU IS SUM OF MULTIPLIED ELEMENTS
1400 DIM D(RB)
1410 SU=0
1420 FOR I=1 TO RA
1430 FOR J=1 TO CA
1440 SU=SU+(A(I,J)*B(J))
1450 NEXT J
1460 D(I)=SU
1470 SU=0
1480 NEXT I
1490 RETURN

```

Listing 5a.

```

1280 REM MAT ADD/SUBTRACT
1290 REM IF S(SUBTRACT)=1, SUBTRACT
1300 DIM D(RA,CA)
1310 FOR I=1 TO RA
1320 FOR J=1 TO CA
1330 IF S=1 THEN D(I,J)=A(I,J)-B(I,J):GOTO 1350
1340 D(I,J)=A(I,J)+B(I,J)
1350 NEXT J
1360 NEXT I
1370 RETURN

```

Listing 4.

```

1500 REM MAT MULT, B IS A MATRIX
1510 DIM D(RA,CB)
1520 SU=0
1530 FOR I=1 TO RA
1540 FOR J=1 TO CB
1550 FOR K=1 TO CA
1560 SU=SU+(A(I,K)*B(K,J))
1570 NEXT K
1580 D(I,J)=SU
1590 SU=0
1600 NEXT J
1610 NEXT I
1620 RETURN

```

Listing 5b.

trix; that is, a square matrix containing all 0s, except for the elements on its main diagonal, which are all 1s. A property of the identity matrix is that if a matrix is multiplied by an identity matrix of equal dimension, the result will be the original matrix. Thus, the identity matrix behaves in matrix multiplication much like the constant 1 does in ordinary multiplication.

The simplest way to get an identity matrix is to first call MAT ZER and then the subroutine shown in Listing 6. MAT ZER will fill the matrix with all 0s, and the subroutine in Listing 6 will put 1s along the main diagonal of the matrix.

Listing 7 shows the subroutine for MAT TRN, which causes the rows and columns of a matrix to be transposed or interchanged. Matrix B is used to hold the transposed matrix; matrix A, the matrix to be transposed, is left unaltered, which lets you use both the original and the transposed matrices in any subsequent operations.

MAT INV finds the inverse of a square matrix. The product of a matrix and its inverse gives an identity matrix. The subroutine shown in Listing 8 uses *inversion-in-place*, meaning that the original matrix is replaced with its inverted form as the

```

1630 REM PUT 1S IN MAIN DIAGONAL
1640 FOR I=1 TO RA
1650 J=I
1660 A(I,J)=1
1670 NEXT I
1680 RETURN

```

Listing 6.

inversion process takes place. This method uses less memory than methods that require a temporary storage matrix. One drawback, however, is that the original matrix is lost; therefore, if the original matrix is needed for further operations, it should be saved in another matrix prior to calling MAT INV.

The subroutine for the final MAT function, the one used to find the determinant of a square matrix, is shown in Listing 9. Once again, matrix A is altered during this operation, so if you need the original matrix A for other operations, save it prior to calling the DET function. The numerical value for the determinant is returned in the variable S.

An Example

Now that you have all of the MAT

```

1690 REM MAT TRN
1700 DIM B(CA,RA)
1710 FOR I=1 TO RA
1720 FOR J=1 TO CA
1730 B(J,I)=A(I,J)
1740 NEXT J
1750 NEXT I
1760 RETURN

```

Listing 7.

functions available, a simple example will illustrate their usefulness. Suppose that you have the following set of equations:

$$2X_1 - 2X_2 + 5X_3 = 13$$

$$2X_1 + 3X_2 + 4X_3 = 20$$

$$3X_1 - 1X_2 + 3X_3 = 10$$

You would like to determine the values for X_1 , X_2 and X_3 such that all of the equations are satisfied. If you fill matrix A with the coefficients of X_1 , X_2 and X_3 so that:

$$A = \begin{bmatrix} 2 & -2 & 5 \\ 2 & 3 & 4 \\ 3 & -1 & 3 \end{bmatrix}$$

$$A = \begin{bmatrix} 2 & 3 & 4 \\ 3 & -1 & 3 \end{bmatrix}$$

$$A = \begin{bmatrix} 2 & 3 & 4 \\ 3 & -1 & 3 \end{bmatrix}$$

and if you fill matrix B with the right hand sides of the three equations so that:

```
13
B= 20
10
```

you can determine the values for X_1 , X_2 and X_3 by the equation $D=INV A \times B$. In other words, matrix D, which contains the numerical values for X_1 , X_2 and X_3 , can be found by taking the inverse of the matrix containing the coefficients (matrix A) and then multiplying this inverse by matrix B, which contains the right hand sides of the equations.

A program to do all of this is shown in Listing 10. Line 2130 contains a subroutine that is simply a routine to MAT READ vector B (see Listing 11).

This example could easily have been done by hand using algebra, but imagine having to solve ten simulta-

neous equations, or even 20, by hand. At that point, you'll really appreciate your MAT functions. ■

```
1770 REM MAT INV
1780 REM MAT A IS REPLACED WITH ITS INVERSE
1790 FOR K=1 TO RA
1800 FOR J=1 TO RA
1810 IF J=K GOTO 1830
1820 A(K,J)=A(K,J)/A(K,K)
1830 NEXT J
1840 A(K,K)=1/A(K,K)
1850 FOR I=1 TO RA
1860 IF I=K GOTO 1910
1870 FOR J=1 TO RA
1880 IF J=K GOTO 1900
1890 A(I,J)=A(I,J)-A(K,J)*A(I,K)
1900 NEXT J
1910 NEXT I
1920 FOR I=1 TO RA
1930 IF I=K GOTO 1950
1940 A(I,K)=-A(I,K)*A(K,K)
1950 NEXT I
1960 NEXT K
1970 RETURN
```

Listing 8.

```
1980 REM DET FUNCTION
1990 FOR I=1 TO RA-1
2000 FOR J=I+1 TO RA
2010 Q=A(J,I)/A(I,I)
2020 FOR K=1 TO RA
2030 A(J,K)=A(J,K)-(A(I,K)*Q)
2040 NEXT K
2050 NEXT J
2060 NEXT I
2070 S=1
2080 FOR I=1 TO RA
2090 S=S*A(I,I)
2100 NEXT I
2110 REM S IS VALUE FOR DETERMINANT
2120 RETURN
```

Listing 9.

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```
10 REM SOLVE 3 SIMULTANEOUS EQUATIONS
15 REM READ MATRIX A
20 RA=3
30 CA=3
40 DATA 2,-2,5
50 DATA 2,3,4
60 DATA 3,-1,3
70 GOSUB 1000
75 REM READ VECTOR B
80 RB=3
90 DATA 13,20,10
100 GOSUB 2130
105 REM FIND INVERSE OF MATRIX A
110 GOSUB 1770
115 REM MULTIPLY INVERSE A AND VECTOR B
120 X=RB
125 PRINT
130 GOSUB 1380
135 REM OUTPUT RESULT
140 FOR I=1 TO RA
150 PRINT "X";I;"=";"D(I)
160 NEXT I
170 END
```

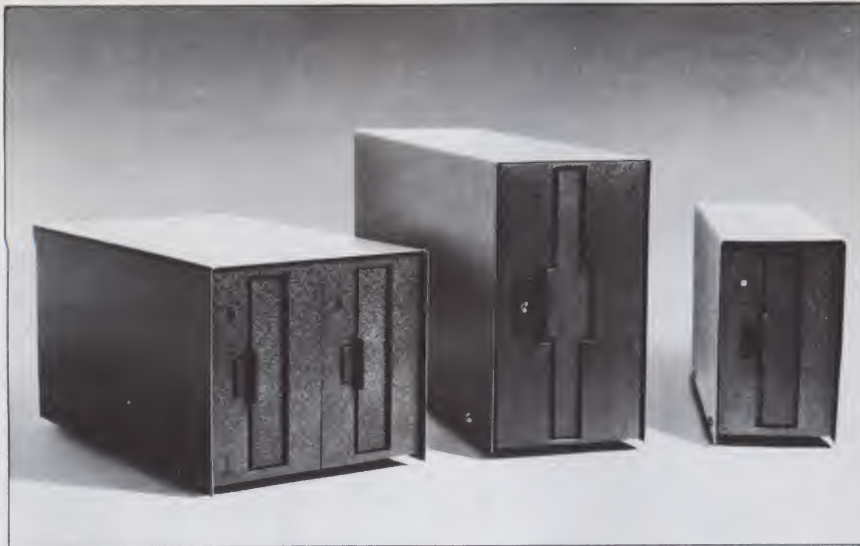
```
OK
run
```

```
X 1 = 1
X 2 = 2
X 3 = 3
```

Listing 11.

```
2130 REM READ VECTOR B
2140 DIM B(RB)
2150 FOR I=1 TO RB
2160 READ B(I)
2170 NEXT I
2180 RETURN
```

Listing 10.



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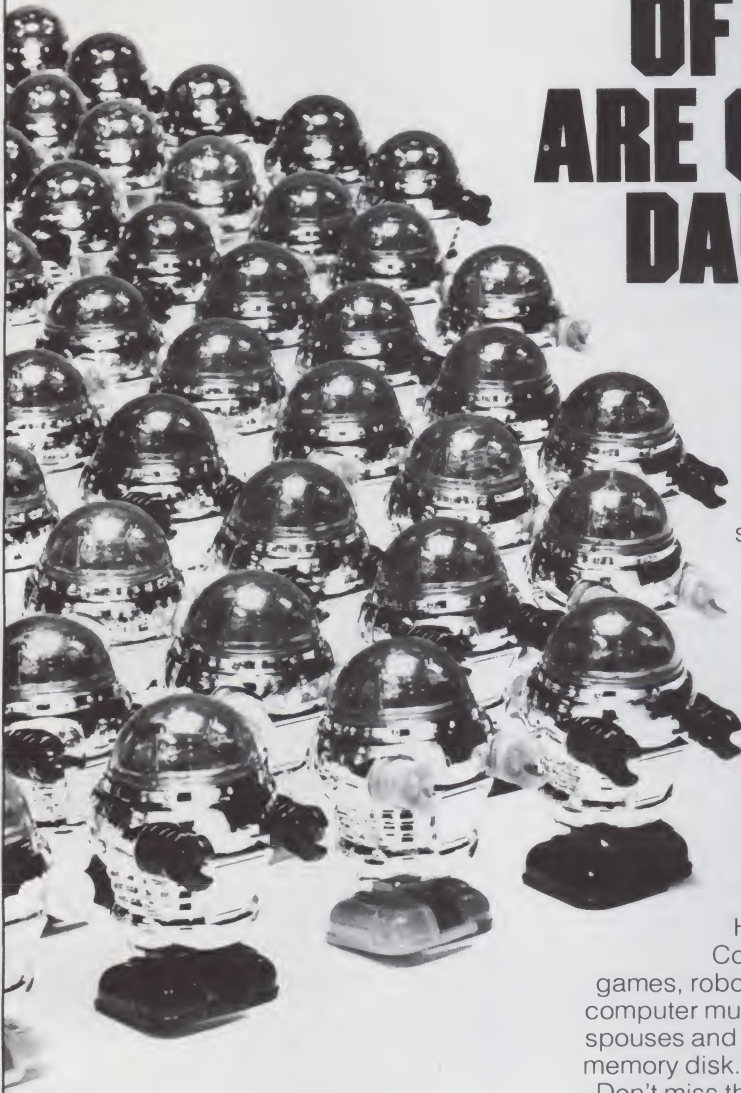
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PET Shorthand Compleat

By Gary L. Ratliff

The idea of shorthand is nothing new to old-time computer users. My first exposure to computer programming 15 years ago was through a book that introduced a 24-bit code. All the coding was in binary, which was tedious to use. Hexadecimal and octal are used as shorthand for the more cumbersome binary. Assembly-language programming is still a further approach that makes the operation codes of the computer more meaningful for human users.

Shorthand is an integral part of some high-level languages and an added feature of several of the BASIC-speaking computers for the home user, "personal computer" market. APL has a number of its functions available with a single key-stroke. FORTH offers the user the ability to virtually define his program using as short a "word" as he desires. The Bally Arcade offers its BASIC with all keywords available at a single stroke of one key. The shorthand of the Level I TRS-80 is useful and well documented in the user's manual. The shorthand is no longer available once the owner upgrades to the more versatile Level II system.

That the Commodore PET also has available a shorthand that may be used either within a program or in the direct mode is not so well known. Its presence was mentioned in an ear-

ly issue of *Cursor*, the cassette magazine for PET users. The purpose of this article is to expand on that original idea and explain its use and its limitations.

PET's Secret Code

The idea is very simple. Most keywords in PET BASIC may be obtained by entering the first letter of the word followed by the shifted second letter of the word. Since the shifted graphic characters are difficult to reproduce, the tables and the examples presented assume that the user has set his computer in the lowercase alphabetic mode. This is done by entering the direct statement: POKE% (\$*,!\$. This is exactly what the screen of your PET may look like using shorthand if you fail to change modes. By changing modes this becomes readable: POKE 59468, 14. Now the second letter of the keyword shifted appears to be a lowercase letter.

Just a little thought and some time spent in constructing an alphabetic list of the PET keywords will clearly reveal why this method won't work for all keywords. The most obvious fact is that many of the keywords are only two bytes anyway. Therefore, even if this method works for them, there is nothing to gain by using this method on words only two letters long.

The next exception is obviously keywords that begin with the same

first two letters, for example, STOP, STEP, STR\$ or INPUT, INPUT#, INT. Many of these exceptions may still be successfully converted into shorthand by differentiating them on the third letter. St is shorthand for STOP; while the three letter code StE gives STEP and STR gives STR\$. Table 1 shows a list of PET BASIC keywords and their shortened versions.

Now that we are equipped with a table of values to convert programs into this shorthand, let's test our new knowledge by trying a short example:

```
10 OPEN 1,1,1,"DATA"
20 FOR I=1 TO 25
30 PRINT#1,I
40 PRINT I
50 NEXT
60 CLOSE1
70 PRINT "DONE";TAB(15)"STOP"
80 END
```

Using the multiline feature of the Microsoft BASICs and the PET shorthand feature, this entire program may be entered as a one-liner as follows:

```
50p1,1,1,"DATA":FoI=1TO25:Pr1,I:Ta1:Ne:CL
o1:?"DONE";Ta15j"STOP":En
```

Before running this program, remove your cassette tape from your tape drive. The program creates a file called DATA which contains the first positive integers from 1 to 25. If you have a tape containing several programs and you run this program, it will create this file on top of your program tape. If this was a commercial

Gary L. Ratliff, 101 East St., Mendenhall, MS 39114.

program for which you paid several dollars, you would not be happy to have the program destroy one of your tapes.

Now type Ru and hit return. You will read the numbers on the screen and hear the cassette motor turn on and then off. Now type Li and hit return. Notice that the shorthand you entered has been expanded to the full PET keywords.

One of the principle uses for this shorthand is the effective lengthening of the BASIC input buffer. This buffer is 80 bytes or two screen lines. If the full text of the keywords is typed, then maximum use of a line cannot be realized. By using shorthand the fact that user-defined functions may only be one line in length may be reduced. Therefore, with shorthand, more involved user functions may be created.

To demonstrate how the buffer is lengthened, let us consider another example. The following is a one-line direct statement that will give an ASCII dump of the variables contained within a BASIC program:

```
FORI=256*PEEK(125)+PEEK(124)TO256*P
EEK(127)+PEEK(126)STEP7:PRINTPEEK(I);P
EEK(I+1):NEXT
```

This statement is 86 bytes. Even using the ? for PRINT will only reduce it to 82 bytes. But with PET shorthand it is only 66 bytes. Now the statements will work as a direct statement and the extra luxury of 14 bytes even allows us to include a timing loop to slow down the listing:

```
FoI=256*Pe(125)+Pe(124)TO256*Pe(127)+P
e(126)STe7:Pe(I);Pe(I+1):FoJ=1TO999:Ne:Ne
```

By the use of shorthand in this example, we have created a direct statement 103 bytes in length. This means that we have effectively increased the input buffer by 28.75 percent.

One additional technique that may prove of value to persons who want to design complex functions through the use of the user-defined function feature is spoon-feeding the line into the program. The user-defined function should be the first line entered. The line is translated into its token symbols and its numerical ASCII values. (Jim Butterfield's tables (see References) make this task much easier.)

Next, these token values are directly poked into the program via direct statements. Be sure to follow the end of the line with an additional poking of two zeros. This is to signal the BASIC interpreter that there are no further lines to follow. Failure to do this

Key	Short	Key	Short	Key	Short
ABS	Ab	INPUT#	In	READ	Re
AND	An	INPUT	N/A	RESTORE	REs
ASC	As	INT	N/A	RETURN	REt
ATN	At			RIGHT\$	Ri
		LEN	N/A	RND	Rn
CHR\$	Ch	LET	Le	RUN	Ru
CLOSE	CLo	LEFT\$	LEf		
CLR	Cl	LIST	Li	SAVE	Sa
CMD	Cm	LOAD	Lo	SGN	Sg
CONT	Co	LOG	N/A	SIN	Si
COS	N/A			SPC	Sp
		MID\$	Mi	SQR	Sq
DATA	Da			STOP	St
DEF	De	NEXT	Ne	STEP	STe
DIM	Di	NEW	N/A	STR\$	STr
		NOT	No		
END	En			TAB	Ta
EXP	Ex	ON	N/A	TAN	N/A
		OR	N/A	THEN	Th
FOR	Fo	OPEN	Op	TO	N/A
FRE	Fr				
		PEEK	Pe	USR	Us
GET	Ge	POKE	Po		
GET#	N/A	POS	N/A	VAL	Va
GOTO	Go	PRINT#	Pr	VERIFY	Ve
GOSUB	GOs	PRINT	?		
				WAIT	Wa
IF	N/A	REM	N/A		

Notes: Both TAB and SPC have the leftmost parentheses included when this shorthand is used. Therefore, PRINT TAB (15);"ACCT.NO." should be coded using this method: ?Ta15);"ACCT.NO."

CONT is only usable as a command, and, if used within a program, it gives an error condition which must be removed.

Table 1. PET BASIC keywords and their shortened versions.

step will result in a system crash in most cases. Now list, and you should see this line as the first and only line of the program text. The rest of the program may be entered using the more conventional keyboard entry of the text.

To demonstrate this method without giving a specific example, it is suggested that if the reader has access to the Mike Stone article on program overlays, which was reprinted in the *PET Gazette*, he try using the direct POKE technique with the program listed in the article. The linking and translation of the token symbols and ASCII values is already done. The correct start for this example is:

```
POKE1025,11:POKE1026,4:POKE1027,10:PO
KE1028,0:POKE1028,65 etc.
```

Advantages

1. There is a lesser chance of error as less material must be typed. If you examine all your key-in errors you will probably find that most of them occur closer toward the end of the word.

2. Expands the range of the line by

allowing more lines to be used with the multiline feature already in this machine.

3. Shorter keywords should mean that once the technique is learned it should be possible to enter your programs faster.

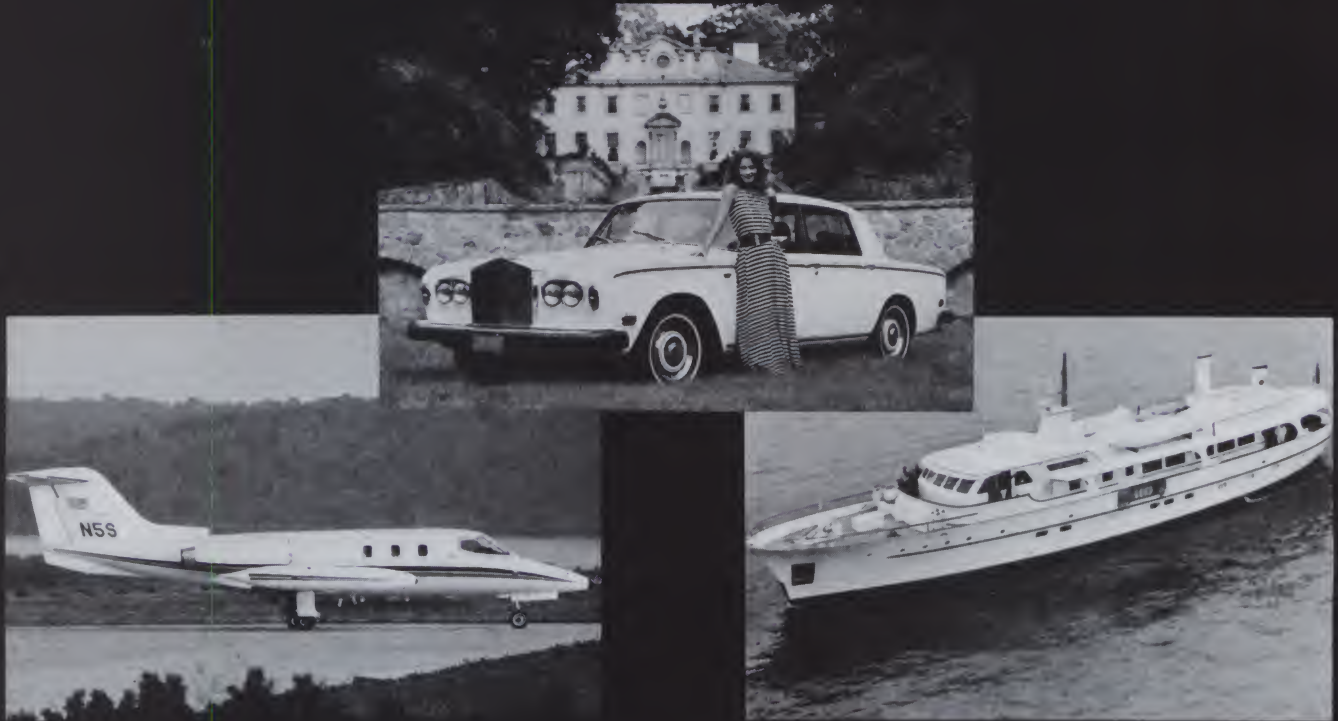
4. More complex user-defined functions and direct statements. (The usefulness of direct statements in debugging may be enhanced by including debugging routines within the text of the program. Then these tests may be performed from the keyboard by a direct command GOsX, where X is the line number of the debugging routine. However, none of these subroutines should call on the INPUT function.)

Disadvantage

The main weakness of using PET shorthand is that lines that expand to more than 80 bytes may not be edited with the screen editor. The longest possible line with PET BASIC will list out at 242 bytes. This line would consist of a line number and ?:. A one-digit line number would allow the

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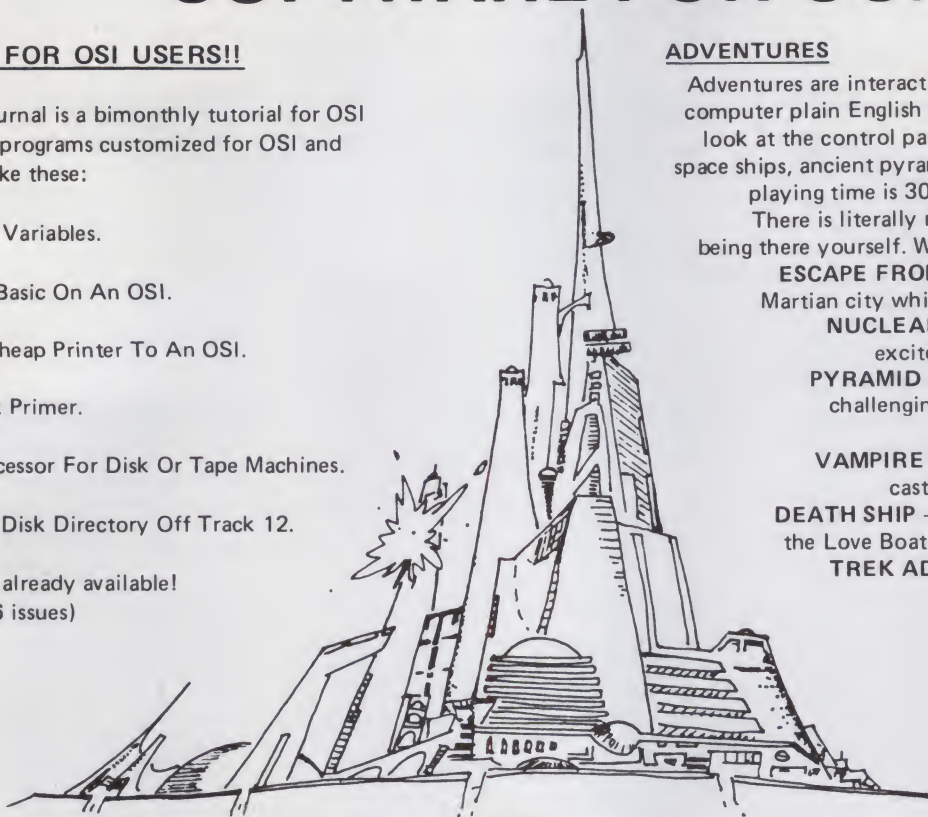
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The Executive Computer Conference, sponsored by *Infosystems*, will be held April 13–14, 1981, in Washington, D.C. It will focus on key aspects of the computer's contribution to organizational productivity from a senior management perspective. For further information, contact the conference chairman, Kendall Burroughs, The Executive Computer Conference, 1730 North Lynn St., Suite 400, Arlington, VA 22209, 703/521-6209.

Micros and Education

Microcomputers and Education Second Annual Tri-state Conference, sponsored by the Center for the Advancement of Teaching and Learning (CATALYST), will be held at the Jersey City State College on March 6 and 7, 1981. The conference, which will feature speakers, workshops and exhibits, will examine the uses of microcomputers in the school and college curriculum and ways to improve computer literacy at all levels of education. For more information, contact CATALYST, Microcomputer Conference, Jersey City State College, 2039 Kennedy Boulevard, Jersey City, NJ 07305, 201/547-3094 or 3098.

College Symposium

The 14th Annual Small College Computing Symposium will take place March 13–14, 1981, at Augustana College. For further information, contact Joseph Pagone, director of Computer Science Education, Augustana College, Sioux Falls, SD 57197.

use of 40 ?s and 39 :s. To list this on the screen will take just over six lines of the screen.

One method to avoid this difficulty is to start entering a line mid screen. Now when listing the line your shorthand version will not scroll off the top of the screen. If you now find an error, it will be possible to correct it in the shorthand version of the text on the screen. ■

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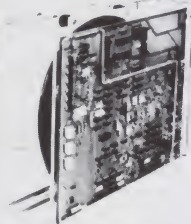
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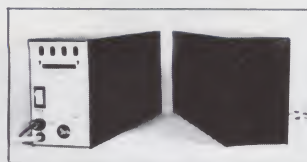
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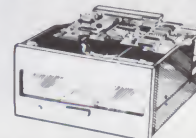
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MICRO QUIZ

(from page 20)

Answer: 9

At statement 70:

X(1) = 4 X(4) = 5

X(2) = 9 X(5) = 1

X(3) = 2 X(6) = 8

Statement 90 changes the value of V only when it reaches an element of X greater than V's current contents. Thus, V contains the largest element of X.

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8212C	Two SA801 in cabinet w/power
5212	Two SA851 in cabinet
5212C	Two SA851 in cabinet w/power

TRS80

MODEL NO.	DESCRIPTION	MODEL NO.	DESCRIPTION
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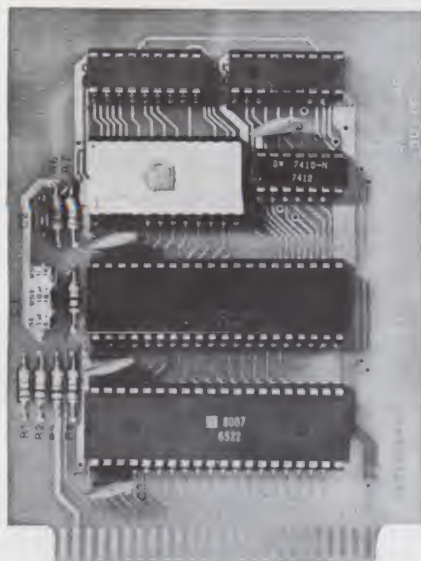
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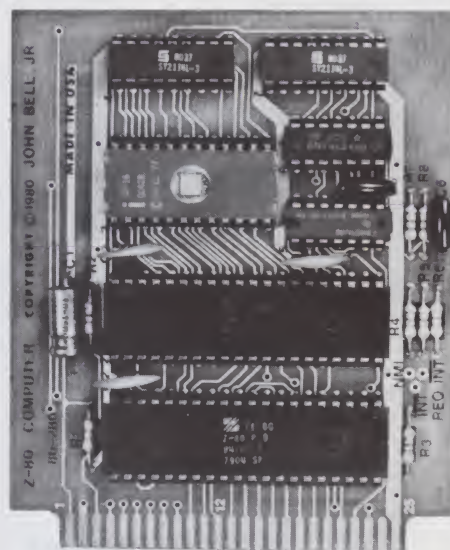
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SCROLL^{ed} OUT^{ed} SET^{ed} KILL^{ed} EAT^{ed} PRINT USING^{BS} SEND^{BS} BEEP^{BS}**

```

RUN
?DIVISION BY ZERO ERROR IN 500
READY.
HELP
500 J = SQR(A*B/(G))
READY
    
```

```

APPEND "INPUT"
PRESS PLAY ON TAPE #1
OK
SEARCHING FOR INPUT
FOUND INPUT
APPENDING
READY.
    
```

```

RUN
READY.
DUMP
A1 = 10
BW = -6.1
CS = "HI"
READY.
    
```

NOTES:

ed — a program editing and debugging command

B80 — a BASIC command also available on Commodore CBM™ 8016 and 8032 computers.

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EXECUTE^{BS} SCROLL^{ed} OUT^{ed} SET^{ed} SEND^{BS} PRINT USING^{BS} BEEP^{BS}**

```
100 GOSUB 180
105 PRINT USING CS, A, BS
130 INPUT "TIME", DS
131 INPUT "DAY", ES
160 IFB< -C THEN 105
180 FOR X=IT09
183 PRINT Y(X):NEXT
184 RETURN
200 I=X/19
READY
RENUMBER 110, 10, 105-184
READY
LIST
100 GOSUB 150
110 PRINT USING CS, A, BS
120 INPUT "TIME", DS
130 INPUT "DAY", ES
140 IFB< -C THEN 110
150 FOR X=IT09
160 PRINT Y(X):NEXT
170 RETURN
200 I=X/19
READY
```

```
MERGE D1 "BUY NOW*"
SEARCHING FOR BUY NOW*
LOADING
READY
RENUMBER 100, 10
READY
FIND BS
110 PRINT USING AS, BS, BS+CS+DS
290 BS="NOW IS THE TIME"
READY
```

```
580 BA=BA-1
590 RA=123*5X/92+BA*10
600 IF BA=143 THEN 580
610 RETURN
620 CS="PROFIT $,###.## DAILY"
630 PRINT USING CS, PI
640 DS="LOSS $,###.## DAILY"
650 PRINT USING DS, LI
RUN
PROFIT $1,238.61 DAILY
LOSS $ 0.00 DAILY
READY
```

```
180 FOR A=4096T08191:DOKEA, B:B-B-1:PRIN
T B:IFB<255 THEN B=B-255:PRINT B
TRACE
```

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ORDER ENTRY/ACCOUNTS RECEIVABLE SYSTEMS



Fyrnetics President, Larry Larsen, and Controller, Dennis Turek, considering some of the features of their new security system.

generated such a high volume of sales orders and invoices that it became necessary to install a computer system in 1977 in order to handle the multi-million dollar annual sales volume.

"Fyrnetics initially installed a Wang 2200 computer system, equipped with seven CRT terminals, four 10 megabyte hard disk drives, and two line printers at a monthly lease cost of over \$4000.00. By late 1979, the company had invested nearly six man-years in our own software development", comments Fyrnetics president, Larry Larsen "As a part of a cost cutting program, we decided to replace the Wang equipment with a microcomputer system. We reviewed all available micro systems and concluded that the MSI hardware and software packages were best suited to our needs."



"We were particularly pleased with the system-generation capability of the MSI business packages, which allowed us to utilize our existing continuous form sales orders, invoices, and packing lists. The requirements for our computer system were rather demanding since we had large customers such as Montgomery Wards and Wicks, each having up to 300 stores. Each store is treated as an individual customer during the order entry and shipping process. However, payment is made from a central accounting office with many stores on a single check. Our system had to allow us to properly credit the payment to many different store locations and invoices. This feature was a part of the MSI Accounts Receivable software package. **Our accounts receivable system handles over 750 regular customers with over 3000 open invoices and 10,000 transactions per month for us."**

The LIFESAVER line of wireless home security products manufactured by Fyrnetics, Inc. Anyone desiring more information on this interesting product line should contact Fyrnetics, Inc. at the above address.

**THE COMPANY:
FYRNETICS, INC.
1021 DAVIS ROAD
ELGIN, ILLINOIS 60120
312-742-0282**

Fyrnetics, Inc. of Elgin, Illinois has grown from a private manufacturer of ionization smoke detectors for companies, such as Sears & Roebuck, to a full line manufacturer of wireless security products which are sold through a worldwide network of dealers and distributors. Since saturation of the residential security market is estimated to be less than 3% in the United States, their major marketing effort has been directed toward distribution through dealers who demonstrate and sell electronic products to the consumer. This marketing approach



The modern production facility at Fyrnetics, Inc. where wireless home security products are designed and manufactured. The company also has production facilities in Hong Kong where larger quantities of their products are manufactured.

CONSIDERATIONS FOR THE SELECTION OF ACCOUNTS RECEIVABLE SYSTEMS

The selection of business computer systems today involves the careful consideration of many different factors. Even though the cost of computer systems has dropped substantially, we considered the selection process to be highly critical to us because of the tremendous need for a highly reliable computer system in our daily operations. Due to our high volume of sales transactions we were highly dependent upon the system for order processing and for information. We considered the following issues to be key to our selection of the MSI system:

LARGE DATA BASE - The processing of over 700 orders per month, with 3000 open invoices and 5000 active statement items required that we have easy and efficient on-line access to our large data base. The MSI system provides a large selection of data reports for open orders, backorders, invoices, credit memos, as well as customer statements and account status information.

EFFICIENT PAPERWORK FLOW - The processing of our large volume of sales orders required an efficient system for printing sales orders, packing lists, invoices, and customer statements. The MSI system offers a convenient system generation program which allows the use of any desired format for pre-printed continuous forms. In addition, packing lists and customer invoices are generated automatically as sales orders are processed.

GENERAL LEDGER TIE-IN - Due to the large volume of individual invoices and cash receipts, we required an automatic posting procedure for our general ledger programs in order to minimize the data entry process. The MSI system offers a complete general ledger program package which links automatically to the other business program modules. All invoices, as well as cash receipts, are automatically written to the general ledger posting files from which individual journals are created. This procedure insures the generation of balanced journals and greatly reduces the time requirement for generation of monthly income statement and balance sheets.

SYSTEM INTEGRATION - The MSI system is fully integrated. The order entry system is linked to inventory for correct pricing, description of items on order. The inventory system is also linked to general ledger to allow different categories of products sold to be automatically posted to the correct sales accounts. The MSI inventory system provides complete cost accounting information for both labor and material. **The MSI programs provide the big machine capability that we need and yet provide the flexibility that we desire.**



The MSI computer system drives two line printers at Fyrnetics, Inc.



The MSI computer system at Fyrnetics, Inc. employs 10 megabyte hard disk drives to contain the large on-line data base.

SUPPORT - The availability of source listings for all of the MSI business software was an added incentive to select the MSI system. This has allowed us to make some specialized enhancements to our programs easily. **MSI really delivered for us allowing the replacement of an expensive WANG 2200 system with a comparable MSI system at a fraction of the cost.**

If you would like to have more information on MSI business computer systems, call or write, **Midwest Scientific Instruments, Inc., 220 W. Cedar, Olathe, KS 66061, 800-255-6638, Telex 42525(MSI A OLAT).**

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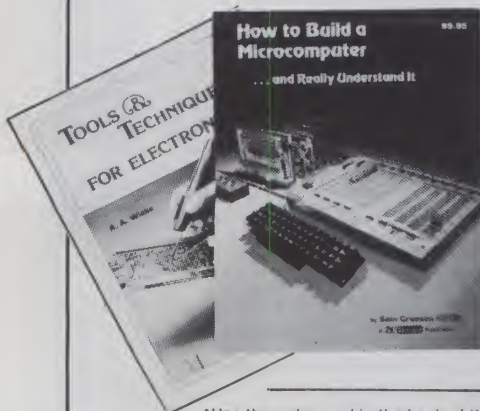
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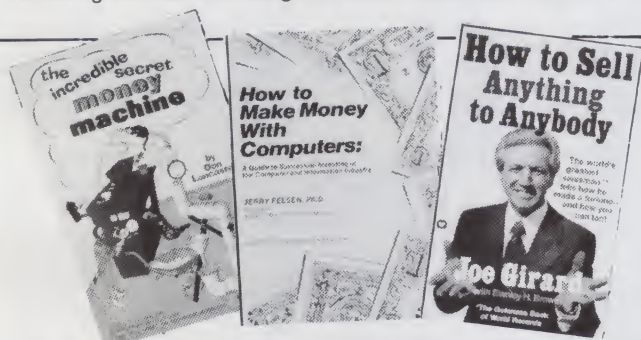
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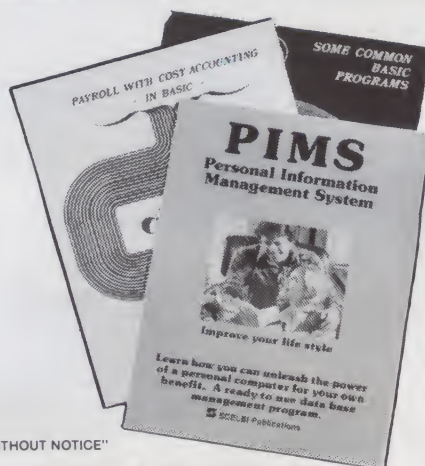
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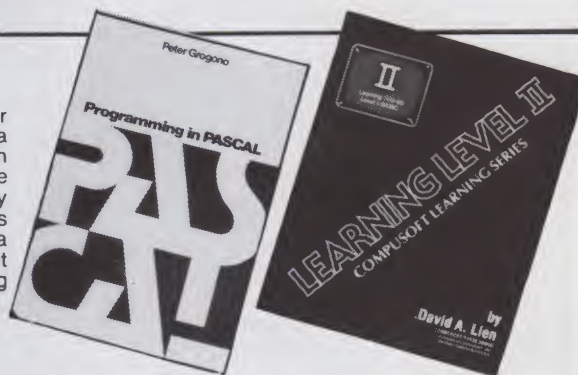
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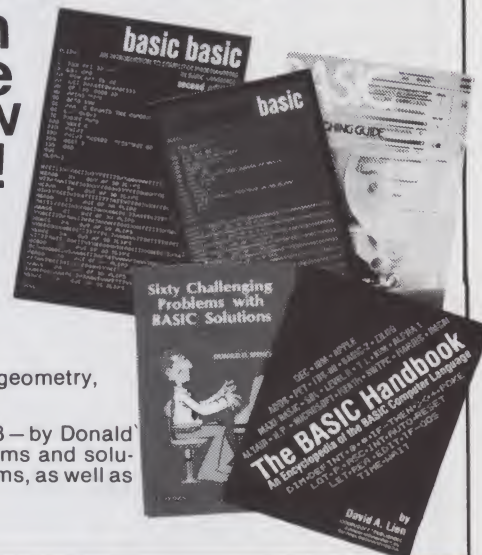
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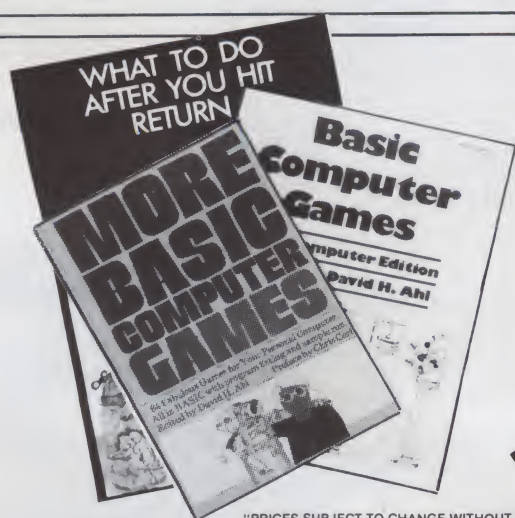


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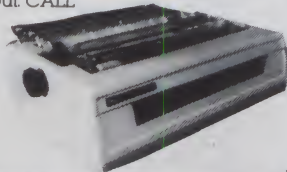
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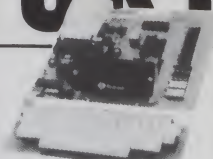


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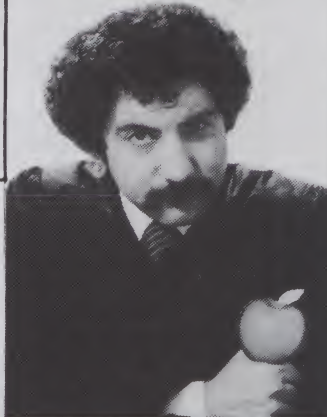
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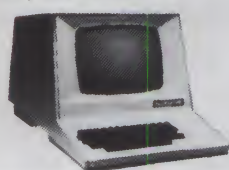
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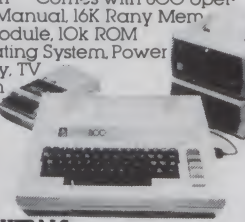
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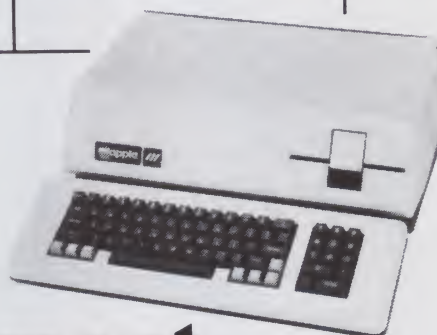
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- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user, expandable to five on-board.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes.
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
 - Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
 - Full duplex 20mA Teletype Interface
 - System Expansion Bus Interface
 - TV Controller Board Interface
 - CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL Lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD

QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. All boards carry full 90-day warranty.

All products that we manufacture are designed to meet or exceed industrial standards. All components are first quality and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

Our money back guarantee: If, for any reason you wish to return any board that you have purchased directly from us within ten (10) days after receipt, complete, in original condition, and in original shipping carton; we will give you a complete credit or refund less a \$10.00 restocking charge per board.

VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard \$139.00

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only 8K of RAM (1/2 populated) \$239.00

VAK-3 Complete set of chips to expand above board to 16K \$125.00

VAK-4 Fully populated 16K RAM \$325.00

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ± 12 VDC, but has a DC to DC

multiplier so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer \$249.00

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. EPROMs not included.

VAK-6 EPROM Board \$119.00

VAK-7 COMPLETE FLOPPY-DISK SYSTEM

See May Kilobaud for details

\$1299.00

VAK-8 PROTOTYPING BOARD

This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

VAK-8 Prototyping Board \$39.00

POWER SUPPLIES

ALL POWER SUPPLIES are totally enclosed with grounded enclosures for safety, AC power cord, and carry a full 2-year warranty.

FULL SYSTEM POWER SUPPLY

This power supply will handle a microcomputer and up to 65K of our VAK-4 RAM. ADDITIONAL FEATURES ARE: Over voltage Protection on 5 volts, fused, AC on/off switch. Equivalent to units selling for \$225.00 or more.

Provides +5 VDC @ 10 Amps & ± 12 VDC @ 1 Amp

VAK-EPS Power Supply \$119.00

VAK-EPS/AIM—same as VAK-EPS but w/additional 24 volt unregulated (specifically for AIM 65) **\$149.00**

KIM-1* Custom P.S. provides 5 VDC @ 1.2 Amps

and +12 VDC @ .1 Amps

KCP-1 Power Supply \$39.00

*KIM is a product of MOS Technology

Add \$2.50 for shipping & handling for all except AIM 65.

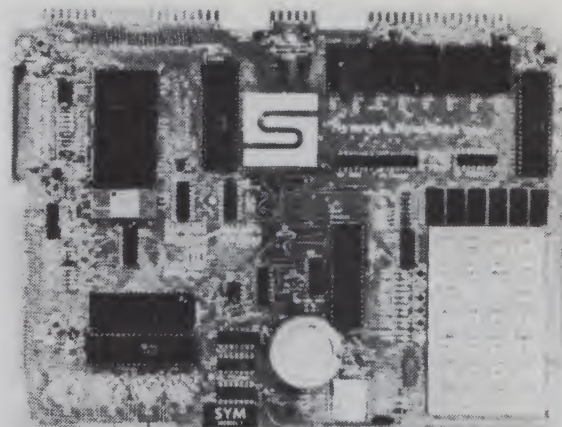
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Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately

SYM-1 Complete w/manuals \$229.00

SYM-1 User Manual Only \$7.00

SYM-1 Expansion \$60.00

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON.

Expansion features that are available:

BAS-18K Basic ROM (Microsoft Basic) \$89.00

KTM-2 (Complete terminal less monitor) \$319.00



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THE COMPLETE PC BOARD HOUSE EVERYTHING FOR THE S-100 BUSS

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- * **FPB-1A** FRONT PANEL BOARD FOR 8080A AND Z80 SYSTEMS IMSAI COMPATIBLE.

PCBD \$56.95 KIT \$175.00

- * **MEM-2** 16K RAM 2114's. ADDRESSABLE IN 4K BOUNDARIES.

PCBD \$33.95 KIT (LESS RAMS) \$80.95

- * **EPM-2** 16/32K ROM USES 2716 OR 2708. ADDRESSABLE IN 4K BOUNDARIES.

PCBD \$33.95 KIT (LESS ROMS) \$74.95

- * **CPU-1** 8080A PROCESSOR BOARD WITH VECTOR INTERRUPT.

PCBD \$33.95 KIT \$124.95

- * **QMB-12** 13 SLOT MOTHER BOARD.

PCBD \$42.95 KIT \$125.95

- * **QMB-9** 9 SLOT MOTHER BOARD.

PCBD \$35.95 KIT \$109.95

- * **PTB-1** POWER SUPPLY AND TERMINATOR BOARD.

PCBD \$29.95 KIT \$49.95

- * **RTC-1** REAL TIME CLOCK BOARD WITH TWO INTERRUPTS.

PCBD \$29.95 KIT \$79.95

- * **MEM-1A** 8K RAM, USES 2102's.

PCBD \$33.95 KIT (LESS RAM) \$71.95

- * **IOB-1** I/O BOARD. ONE SERIAL, TWO PARALLEL WITH CASSETTE.

PCBD \$33.95

- * **FDC-1A** FLOPPY DISC CONTROLLER BOARD USES 1771.

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450 NSECONDS ASSEMBLED AND TESTED.
PART MAY BE REMARKS. 2.5 AMPS TYPICAL.

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WITH WAMECO AND CYBERCOM PCBDS

MEM-3 less RAM \$ 95.95
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With 2114L-2 \$390.00
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RTC-1 with MIKOS #5 real time clock \$65.95
EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS \$65.95
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PURCHASE \$50.00 WORTH OF LS TTL AND GET 10% CREDIT TOWARD ADDITIONAL PURCHASES.
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VISA or MASTERCARD. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30-day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. \$10 minimum order. \$1.50 service charge on orders less than \$10.00.

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32K S-100 EPROM CARD NEW!



\$74.95
KIT

USES 2716's
Blank PC Board - \$34
ASSEMBLED & TESTED
ADD \$30

SPECIAL: 2716 EPROM's (450 NS) Are \$11.95 EA. With Above Kit.

KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

\$379⁰⁰ KIT

NEW!

For 2MHZ
Add \$10

Blank PC Board
\$50

For SWTPC
6800 - 6809 Buss

Support IC's
and Caps
\$19.95

Complete Socket Set
\$21.00

Fully Assembled,
Tested, Burned In
Add \$30

At Last! An affordable 32K Static RAM with full 6809 Capability.

FEATURES:

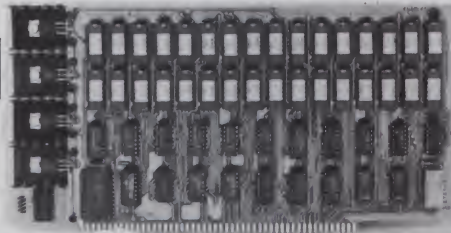
1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

\$199⁹⁵ KIT

FOR 4MHZ
ADD \$10



KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-\$33
LOW PROFILE SOCKET SET-\$12
SUPPORT IC'S & CAPS-\$19.95
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**OUR #1 SELLING
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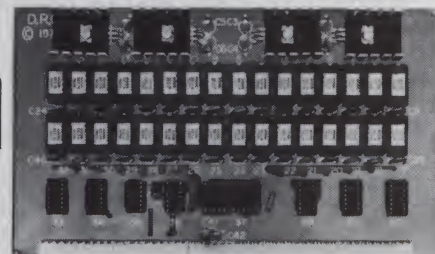
16K STATIC RAM SS-50 BUSS

PRICE CUT!

\$195 KIT

FULLY STATIC!

FOR 2MHZ
ADD \$10



FOR SWTPC
6800 BUSS!

ASSEMBLED AND
TESTED - \$35

KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD-\$35
COMPLETE SOCKET SET-\$12
SUPPORT IC'S AND CAPS-\$19.95

NEW! STEREO! S-100 SOUND COMPUTER BOARD NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES:

- * TWO GI SOUND COMPUTER IC'S.
- * FOUR PARALLEL I/O PORTS ON BOARD.
- * USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- * ON BOARD PROTO TYPING AREA.
- * ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- * PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- * EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
- * USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M™ compatible diskette or 2708 or 2716. Diskette - \$24.95 2708 - \$19.95 2716 - \$29.95. Diskette includes the source. EPROM'S are ORG at E000H.

COMPLETE KIT!
\$84⁹⁵
(WITH DATA MANUAL)

BLANK PC
BOARD W/DATA
\$31

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4K DYNAMIC RAM BLOWOUT! SAME AS INTEL 2107B!

4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. MEMORY DATA BOOK is available at most Radio Shack Stores. Prime units in original factory tubes!

(With Pin
Out Data)

#5280-5N 4096 BITS x 1 270 NS ACCESS

8 FOR \$4.95 32 FOR \$16

FACTORY CASE (450 PCS) — \$180

Sockets Special: 22 Pin Low Profile (With Purchase of 5280's) 8 FOR \$1.

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AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **\$11.95 PRICE CUT!**

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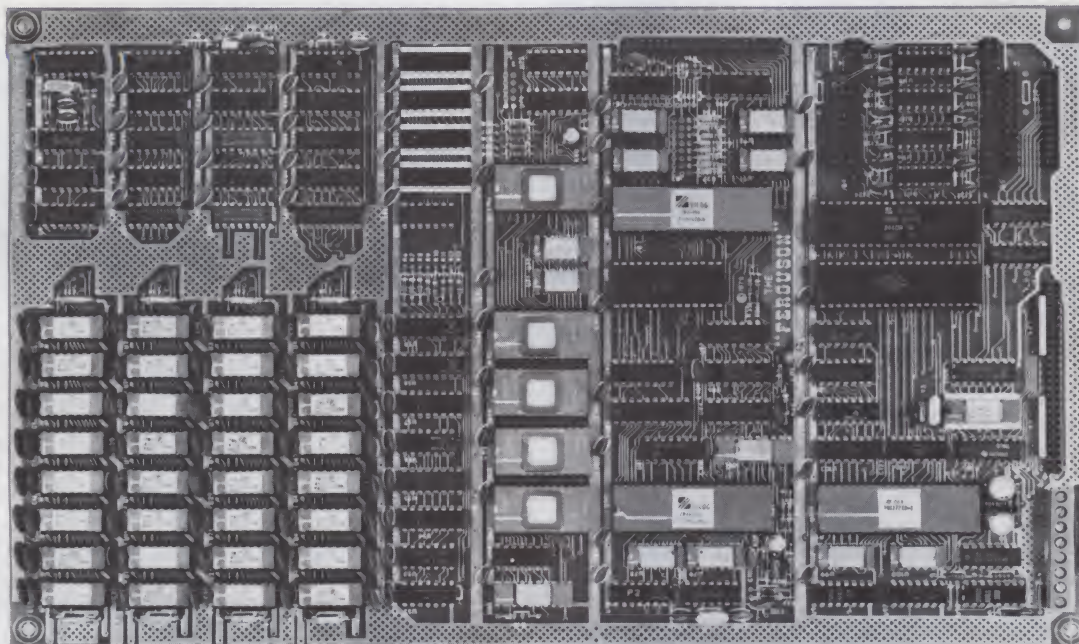
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"THE BIG BOARD" OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC SINGLE BOARD COMPUTER KIT! Z-80 CPU! 64K RAM!

NEW!

PARTIAL KIT
For All Sockets Installed
And Soldered Add \$50.



THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

\$649⁰⁰ ** (64K KIT BASIC I/O)

SIZE: 8 1/2 x 13 1/4 IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ .3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: \$85.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

SYSTEM COMPARISON

64K RAM KIT	\$370.00
80 x 24 Video Kit	365.00
Floppy Disk Controller Kit	235.00
Z-80 CPU Kit	185.95
SER & PAR. I/O	129.95
S-100 Mother Board	45.00
SUB TOTAL	\$1330.90

Talk about bangs per buck! The prices shown for \$100 kits were taken from the July 1980 BYTE. This will give some basis for comparison between the Big Board and a similar system implementation on the S100 Buss.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: \$29.95

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$14.95

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for \$150.00.

PC BOARD

Blank PC Board with Rom Set and Full Documentation.
\$195.00

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.
Z-80 is a Trademark of Zilog.

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TERMS: Initial shipments will be made approximately 3 to 5 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a \$75 deposit. Balance UPS COD. The \$75 deposit assures your place in line for the initial production run of Big Board.

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE ORIGINATORS OF CPM SOFTWARE
**1 TO 4 PIECE DOMESTIC USA PRICE.

SALE SALE SALE

Disk Drives



JADE's new dual disk sub-assemblies include: Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, cooling fan, cable kit, lighted power switch, approved fuse assembly, line cord, Never-Mar rubber feet, and all necessary hardware to mount 2-8" disk drives - it's all American made, guaranteed for six months, and it's in stock!

Dual 8" Sub-Assembly Cabinet

END-000421 Cabinet kit \$225.00
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Single sided, double density disk drive sub-system

END-000423 Kit w/2 8" drives \$975.00
END-000424 A & T w/2 8" drives \$1195.00

Double sided, double density disk drive sub-system

END-000426 kit w/2 8" drives \$1495.00
END-000427 A & T w/2 8" drives \$1695.00

JADE DISK PACKAGE

Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, power supply, fan, & cables

Special package price \$1395.00

8" Disk Drive Sale

Highly reliable double density floppy disk drives

Shugart 801R single sided, double density

MSF-10801R SA-801R \$425.00
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Real Double-Sided Drives 8" Double-Sided Double-Density Sale

* Shugart SA-851R double-sided, double-density *

* only \$625.00 ea 2 for \$1190.00 *

MFE M701 8" double-sided, double-density drives

only \$525 ea 2 for \$1040.00

Qume Data Track 8 double-sided, double-density drives

only \$575.00 2 for \$1100.00

Printers

CENTRONICS 737-1

9 x N dot matrix, letter quality, proportional spacing

PRM-15737 Parallel \$795.00

With interface for Apple \$895.00

MX-80 - Epson

132 column, 9 x 9 dot matrix, multiple fonts

PRM-27080 Save \$100.00 \$545.00

Interface for Apple \$110.00



SPINWRITER - NEC

65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro space justification, data cable, and self test diagnostic ROM.

PRD-55511 without 16K buffer \$2795.00

PRD-55512 with 16K buffer \$2895.00

S-100 Systems

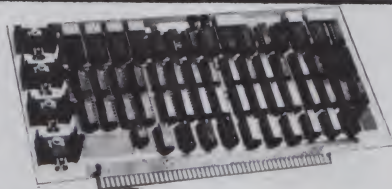
S-100 SYSTEM - Calif Computer Sys

Complete S-100 system including 12 slot mainframe, 4 MHz Z-80 CPU, 64K RAM memory, double density disk controller, RS-232 cable, 8" & 5 1/4" disk drive cables, CP/M 2.2, manuals, auto boot ROM, completely assembled & tested.

2210A Integrated & tested \$1995.00

2210B Not integrated \$1795.00

S-100 Memory



64K RAM - Calif Computer Sys

4 MHz bank port & bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 & Z-80 front panel compatible.

MEM-64565A A & T \$449.95

MEMORY BANK - Jade

4 MHz, IEEE S-100, bank selectable, 8 or 16 bit

MEM-99730B Bare board \$55.00

MEM-99730K Kit, no RAM \$219.95

MEM-16730K 16K kit \$249.95

MEM-32731K 32K kit \$289.95

MEM-48732K 48K kit \$324.95

MEM-64733K 64K kit \$359.95

Assembled & tested add \$50.00

EXPANDORAM II - S D Systems

1 MHz RAM board expandable from 16K to 256K

MEM-16630K 16K kit \$275.95

MEM-32631K 32K kit \$295.95

MEM-48632K 48K kit \$315.95

MEM-64633K 64K kit \$335.95

Assembled & tested add \$50.00

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MEM-16151K 16K 4 MHz kit \$169.95

MEM-32151K 32K 4 MHz kit \$299.95

Assembled & tested add \$50.00

16K STATIC RAM - Cal Comp Sys

2 or 4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks

MEM-16160A 16K 2 MHz A & T ... \$286.95

MEM-16162A 16K 4 MHz A & T ... \$289.95

MEM-16160B Bare board \$50.00

PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K Kit \$154.95

MEM-99510A A & T \$229.95

PROM-100 - SD Systems

2708, 2716, 2732, 2758, & 2516 EPROM programmer

MEM-99520K Kit \$219.95

MEM-99520A Jade A & T \$269.95

S-100 Video

VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit \$375.00

IOV-1095A 4 MHz A & T \$450.00

IOV-1096K 80 x 48 upgrade \$39.95

VIDEO BOARD - Jade

64 characters x 16 lines, 7 x 9 dot matrix, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1050K Kit \$99.95

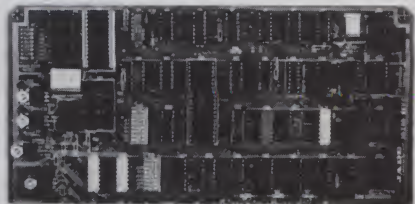
IOV-1050A A & T \$125.00

IOV-1050B Bare board \$19.95

S-100 CPU

2810 Z-80* CPU - Cal Comp Sys

2-4 MHz Z-80A* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible. CPU-30400A A & T \$269.95



THE BIG Z* - Jade

2 or 4 MHz switchable Z-80* CPU with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600

CPU-30201K Kit \$145.00

CPU-30201A A & T \$199.00

CPU-30200B Bare board \$35.00

CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300A A & T \$229.95

SBC-200 - SD Systems

4 MHz Z-80* CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.

CPC-30200K Kit \$339.95

CPC-30200A Jade A & T \$399.95

S-100 Disk Controller

DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2* and manual set.

IOD-1300A A & T \$369.95

DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit \$299.95

IOD-1200A 8" A & T \$389.95

IOD-1205A 5 1/4" A & T \$389.95

IOD-1200B Bare board \$65.00

VERSAFLOPPY II - SD Systems

New double density controller for both 8" & 5 1/4"

IOD-1160K Kit \$379.95

IOD-1160A Jade A & T \$439.95

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ISO-BUS - Jade

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MBS-061B Bare board \$19.95

MBS-061K Kit \$39.95

MBS-061A A & T \$49.95

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MBS-121B Bare board \$29.95

MBS-121K Kit \$69.95

MBS-121A A & T \$89.95

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MBS-181B Bare board \$49.95

MBS-181K Kit \$99.95

MBS-181A A & T \$139.95

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S-100 CARD CAGE - Jade

Metal cage with card guides & fan mounting

ENX-106001 Six slot \$29.95

S-100 CARD CAGE - Vector

19" rack mountable, adjustable, holds 21 cards

VCT-CKK100 Anodized Al \$49.95

SALE SALE SALE

S-100 I/O

S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K	2 CTC's, 1 SIO, 1 PIO	\$199.00
IOI-1045A	A & T	\$259.00
IOI-1046K	4 CTC's, 2 SIO's, 1 PIO	\$259.00
IOI-1046A	A & T	\$319.00
IOI-1045B	Bare board w/ manual	\$59.95
IOI-1045D	Manual only	\$20.00

I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K	Kit	\$179.95
IOI-1010A	A & T	\$249.95
IOI-1010B	Bare board	\$35.00

TERMINATOR - S.S.M.

Active terminator for S-100 bus

TSX-195K	Kit	\$29.95
TSX-195A	A & T	\$54.95
TSX-195B	Bare board	\$22.95

S-100 EXTENDER - Cal Comp Sys

Put those problem boards (the ones you probably bought from one of our competitors) within easy reach.

TSX-160A	A & T	\$37.95
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S-100 PROTO BOARD - Jade

Universal design, plated thru holes, gold fingers

TSX-140B	Bare board	\$24.95
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TERMINATOR & EXTENDER - C.C.S.

Can be used as both an S-100 extender and terminator

TSX-150K	Kit	\$43.95
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Diskettes

DISKETTES - Jade

Bargain prices on magnificent magnetic media

5 1/4" single sided, single density, box of 10

MMD-5110103	Soft sector	\$27.95
MMD-5111003	10 sector	\$27.95
MMD-5111603	16 sector	\$27.95

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MMD-5220103	Soft sector	\$39.95
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8" single sided, single density, box of 10

MMD-8110103	Soft sector	\$33.95
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MMD-8120103	Soft sector	\$39.95
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8" double sided, double density, box of 10

MMD-8220103	Soft sector	\$49.95
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Video Monitors

9" B & W MONITOR - A.P.F.

High quality, high resolution video monitor

VDM-750900	9" monitor	\$159.95
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13" COLOR MONITOR - Zenith

The hi res color you've been promising yourself

VDC-201301		\$449.00
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12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200	12" monitor	\$259.95
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Mainframes

MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

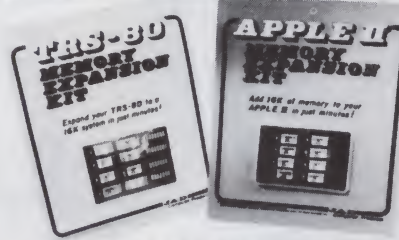
ENC-112105	Kit	\$359.95
ENC-112106	A & T	\$419.95

DISK MAINFRAME - NNC

Holds 2 8" drives and an 8 slot S-100 system. Attractive metal cabinet with 8 slot motherboard, power supply, fan, key switch, and other professional features

ENS-112320	with 30 amp p.s.	\$699.95
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Accessories-Apple/TRS-80



16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

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MEX-16101K	Apple kit	\$29.00
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5 1/4" disk drive with controller for your Apple

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DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty, includes case, power supply, and cable

MSM-12410C	Save \$125.00 !!!	\$299.95
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IOD-2233A	Complete kit	\$64.95
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APPLE STICK - Micromate

Joy stick with pots for Apple II

SYA-1510A	A & T	\$35.95
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Z-80* CARD for APPLE

Z-80* CPU card with CP/M 2.2 for your Apple

CPX-30800A	A & T	\$279.95
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AIO - S.S.M.

Parallel & serial interface for your Apple

IOI-2050K	Kit	\$155.95
IOI-2050A	A & T	\$194.95

PRINTER INTERFACE - C.C.S.

Centronics type I/O card w/ firmware

IOI-2041A	A & T	\$99.95
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APPLE CLOCK - Cal Comp Sys

Real time clock w/ battery back-up

IOK-2100A	A & T	\$109.95
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Modems

LEX-11 MODEM - Lexicon

A real star! 300 baud, answer/originate, RS 232C

IOM-5511A	Best buy !!!	\$128.00
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NOVATION CAT

300 baud, answer, originate acoustic modem

IOM-5200A	1 year warranty	\$179.00
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D-CAT 300 baud, direct connect modem

IOM-5201A	Special sale price	\$189.00
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AUTO-CAT Auto answer/originate, direct connect

IOM-5230A	Special sale price	\$239.95
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MICROMODEM - D.C. Hayes

Auto answer, dial modem card for Apple or S-100

IOM-2010A	Apple modem	\$349.95
IOM-1100A	S-100 modem	\$375.00

MICRONET MODEM - Micromate

Direct connect with extra features - a best buy

IOM-2020A	Best Apple modem	\$275.00
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Single Board Computers



AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals

CPK-50165	1K AIM	\$374.95
CPK-50465	4K AIM	\$449.95
SFK-74600008E	8K BASIC ROM	\$99.95
SFK-64600004E	4K assembler ROM	\$84.95
PSX-030A	Power supply	\$64.95
ENX-000002	Enclosure	\$49.95

4K AIM, 8K BASIC, power supply, & enclosure

Special package price \$625.00

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Complete Z-80* computer with RAM, ROM, I/O, display, keyboard, manual, and kluge area.

CPS-30010K	Kit	\$369.95
CPS-30010A	Jade A & T	\$459.95

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Z-80A	12.95
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6800	11.95
6802	17.95
6809	39.95
8035	24.00
8080A	6.50
8085	15.95
8748	59.95

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10 for \$4.90 ea		
2716	125ns	11.95
2716	5ns	11.95
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2532	5ns	39.95
2732	5ns	39.95
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2114LA	4 MHz	3.95
4116		4.25
4164	60K x1	59.95
5257	2 MHz	6.75
5257A	4 MHz	7.25
MK4118		18.95

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1.843 MHz xtal	4.95

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TMS6011	5.95
IM6402	9.00

6800 SUPPORT

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6850P	4.80
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6875L	7.40
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8224-4	5.75
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8238	4.95
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8253	17.95
8255	6.50
8257	19.95
8259	17.95
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apple II plus apple II

With 48K of memory! \$1199

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APPLESOFT PROGRAMS	\$95
PARALLEL PRINTER	\$99
PROTOTYPING/HOBBI	\$95
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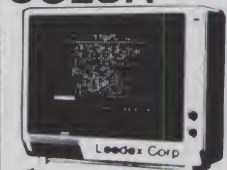
S-100

16K STATIC MEMORY BD.	\$209
32K STATIC MEMORY BD.	\$299
64K DYNAMIC MEMORY BD.	\$339
ADAPTER BOARD, 12 SLOT	\$99
1.80 CPU BD.	\$299
MAINFRAME/RES. & MOD.	\$379
BIOS CONTROLLER BD.	\$65

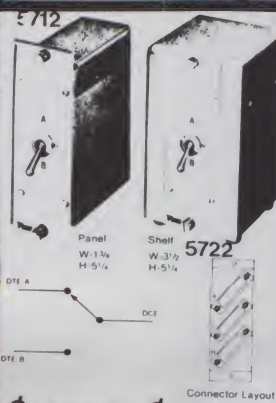
E PROMS

2708 1k x 8	5.95
8 FOR 40.00	
2716 2k x 8	9.95
single p.s.	8 FOR 80.00
2732 4k x 8	24.95
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COLOR



\$397.00 MONITOR 13"



\$14500 \$15500

Description: The RS-232C Compatible Digital Transfer Switch is designed to switch modems between front end processors. All 24 pins of the connector are switched, with Pin 1 wired to ground.

Tbar INCORPORATED

MODEL 8008 IMPACT PRINTER

- Dot resolution graphics in six densities
- 1800 character buffer
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base inc.

MISCELLANEOUS

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NE555V	27
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7908	
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7918	85
7805	
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7808	
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MC1350P	1.15
MC1358P	1.50
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MC1458P	50
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S-100 MEMORY BOARD

16K STATIC RAM

\$249.00

ASSEMBLED & TESTED

California Computer Systems

S-100 16K ADD-ON BARE BOARD

WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK

\$28.95

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No "Glitches", Surges Or Interference

The MPD 117 is the low-cost solution to your power distribution problems.

The MPD 117 has a high performance EMI filter, built-in circuit breaker, two direct and six switched outlets, illuminated on-off switch for switched outlets, and is built with rugged UL approved components and housing in an all steel chassis with convenient mounting flanges.

\$87.50

video 100

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12" BLACK & WHITE LOW COST VIDEO MONITOR

Leadex Corp.



apple clock/calendar

- Seconds, minutes, hours, day-of-week, month, date, & year.
- On board batteries with one year life.
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HEATHKIT® COMPUTER OWNERS WE HAVE H47 COMPATIBLE DISK OPERATING SYSTEM

8" Dual Sided, Double Density Intelligent MASTER/SLAVE

BY REMEX

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SN7404N	.22	SN7493N	.48
SN7408N	.24	SN7495N	.60
SN7410N	.22	SN7496N	.70
SN7412N	.28	SN74122N	.39
SN7413N	.35	SN74136N	.95
SN7414N	.49	SN74141N	.69
SN7416N	.29	SN74151N	.65
SN7417N	.29	SN74153N	.65
SN7423N	.28	SN74154N	1.25
SN7425N	.25	SN74155N	.80
SN7430N	.23	SN74157N	.69
SN7437N	.29	SN74160N	.95
SN7438N	.24	SN74161N	.65
SN7440N	.22	SN74163N	.85
SN7442N	.57	SN74164N	.87
SN7443N	.78	SN74165N	.87
SN7445N	.78	SN74174N	.95
SN7451N	.20	SN74175N	.69
SN7454N	.20	SN74180N	.75
SN7474N	.32	SN74181N	1.15
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MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR

GENERAL DESCRIPTION

The MSM5832 is a monolithic metal-gate CMOS integrated circuit that functions as a real time clock/calendar for use in bus-oriented microprocessor applications. The on-chip 32.768 KHz crystal controlled oscillator time base is counted down to provide addressable 4-bit BCD data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address: chip select, read, write and hold inputs. Other functions include 12hr/24hr format selection, leap year identification and manual 30 second correction.



555TIMER 27c

TMS2716 E-PROM

REQUIRES THREE \$8.50 POWER SUPPS.

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SOROC TECHNOLOGY, INC.



IQ120 \$689

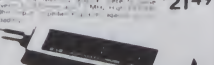
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TRS 80 16K Memory Add-On \$4395

KIT CONTAINS DIP SWITCHES AND DETAILED INSTRUCTIONS

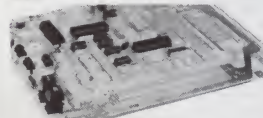
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74LS02	.26
74LS03	.26
74LS04	.26
74LS08	.28
74LS09	.26
74LS10	.26
74LS20	.26
74LS21	.26
74LS22	.26
74LS26	.49
74LS30	.28
74LS32	.32
74LS38	.32
74LS42	.65
74LS48	.78
74LS51	.25
74LS54	.35
74LS74	.38
74LS75	.60
74LS83	.44
74LS85	.95
74LS86	.95
74LS90	.69
74LS93	.69
74LS107	.45
74LS112	.38
74LS113	.48
74LS122	.48
74LS123	.95
74LS126	.69
74LS138	.69
74LS151	.44
74LS153	.44
74LS155	1.15
74LS158	.75
74LS160	.95
74LS161	.85
74LS162	.95
74LS163	1.60
74LS164	.65
74LS165	.65
74LS170	1.75
74LS174	.75
74LS175	.75
74LS180	.75
74LS193	.95
74LS195	.95
74LS196	.85
74LS221	1.40
74LS240	1.65
74LS241	1.65
74LS243	1.45
74LS244	1.45
74LS245	2.25
74LS253	.95
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74LS258	.95
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Start learning and computing for only **\$129.95** with a **Netronics 8085-based computer kit**. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.

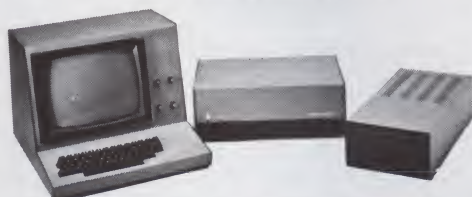
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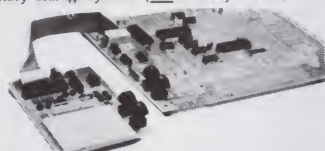
Imagine — for only \$129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only \$129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. \$129.95



Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O ... all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader. • **Cassette tape recorder** input and output. • **Cassette tape control** output. • **LED output indicator** on SOD (serial output) line. • **Printer interface** (less drivers). • **total of four 8-bit plus one 6-bit I/O ports.** • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt. • **additional provisions** for RST 5.5, 6.5 and TRAP interrupts on-board. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems. • **RAM expandable to 64K via S-100 bus or 4k on motherboard.**

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F900, leaving 4000 free for user RAM/ROM. Features include tape load with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ... single step with register display at each break point, a debugging/training feature ... go to execution address ... move blocks of memory from one location to another ... fill blocks of memory with a constant ... display blocks of memory ... automatic baud rate selection to 9600 baud ... variable display line length control (1-255 characters/line) ... channelized I/O monitor routine with 8-bit parallel output for high-speed printer ... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling ... tape dump with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ...

single step with register display at each break point ... go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

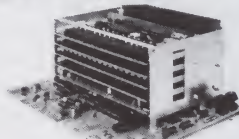
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for on-board 4k RAM expansion selectable in 4k blocks ... address decoding for on-board 8k EPROM expansion selectable in 8k blocks ... address and data bus drivers for on-board expansion ... wait state generator (jumper selectable), to allow the use of slower memories ... two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the origi-

nal 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of on-board RAM).

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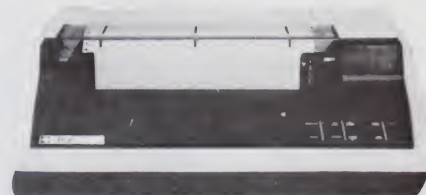
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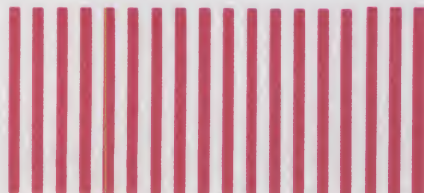
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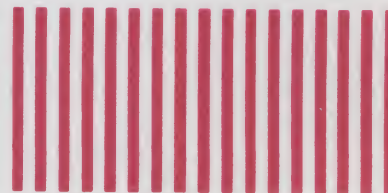
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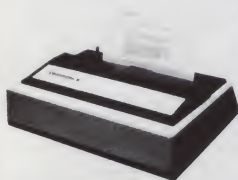
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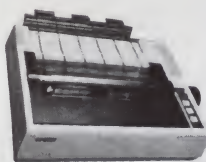
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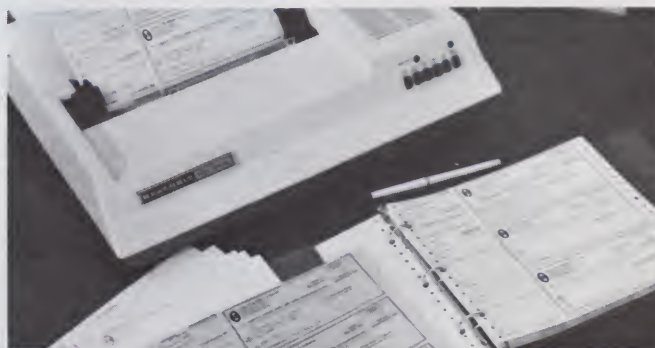
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The business software includes the Information Management Pac, which provides a data base management tool for applications such as list keeping, inventory and reporting, and the Graphics Presentation Pac for producing charts and text for reports and overhead projection transparencies. The new software runs with both the HP-83 and HP-85. Reader Service number 487.

Daisywheel Printer

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Computer Textile, Inc., 10960 Wilshire Blvd., Suite 1504, Los Angeles, CA 90024. Reader Service number 493.

S-100 Error-Correcting Board

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Atari 32K RAM Expansion

A new memory expansion system from Axlon, Inc., 170 N. Wolf Rd., Sunnyvale, CA 94086, upgrades the Atari 400 to 32K and the Atari 800 to 48K RAM. RAMCRAM contains 16 memory chips, yielding a total of 32K of additional user program memory. It is installed in the Atari 400 by removing the top enclosure of the computer console and unplugging the 8K RAM module supplied by Atari. The RAM-

CRAM module is then plugged into the same slot. This allows you to plug in disk drives, printers and any other peripheral devices formerly compatible only with the Atari 800. Any 32K Atari 800 software on the market will run on a 400 with RAMCRAM. For the 800, putting 32K into one memory slot allows upgrading of the system to 48K with one entire slot left over for future expansion. Reader Service number 495.

North Star Floppy Subsystem

An eight-inch floppy subsystem that allows North Star users greater auxiliary storage and the ability to transfer files from 5-1/4-inch media to eight-inch media or vice versa is available from John D. Owens Associates, Inc., 12 Schubert St., Staten Island, NY 10305. This fully integrated hardware/software package is designed to operate in single or double density on eight-inch media in IBM-compatible format.

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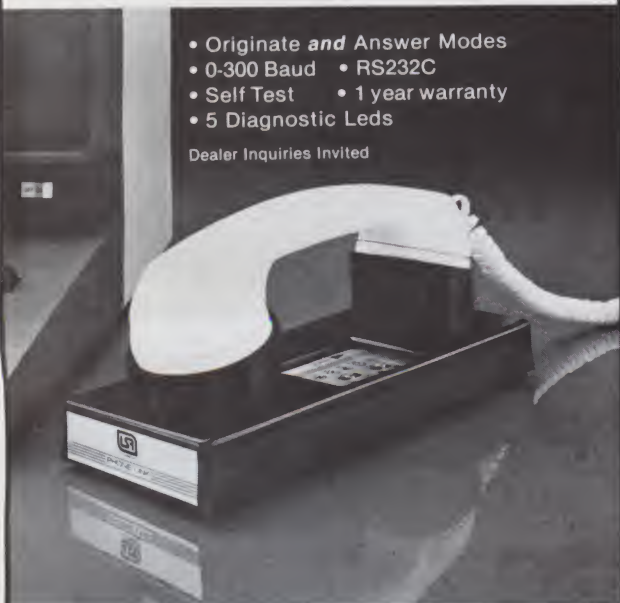
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ROM
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CASSETTE

THE PET RABBIT

4.0
OR
3.0 ROMS

The PET Rabbit is a programmers aid which provides 12 additional commands that can be executed in BASIC's direct mode. In addition to the commands, automatic repeat of any key held down for 0.5 seconds is also provided. This will greatly aid inputtings of characters and provide more convenient cursor control. Most importantly, the RABBIT's high speed recording technique allows an 8K program to be saved in 38 seconds instead of the normal 2 minutes and 44 seconds in Commodore's format. (Note—The RABBIT cannot be used to store data tapes from BASIC.)

The PET Rabbit is 2K of machine code supplied on cassette or in ROM. The cassette version occupies the top-most portion of memory and can be ordered in one of 5 locations: \$1800-\$1FFF for 8K PETs, \$3000-\$37FF for \$3800-\$3FFF for 16K PETs, and \$7000-\$77FF or \$7800-\$7FFF for 32K PETs. The reason for two different versions for the 16K and 32K PETs is to provide room for those programmers who use the DOS Support (wedge) program. (Note—The cassette RABBIT works only with 3.0 ROM PET's.)

The ROM version is a 24 pin Integrated Circuit which plugs into spare socket D4 and occupies memory \$A000-\$A7FF. Since the ROM version does not occupy user RAM, it will work with any 8K, 16K, or 32 K 3.0 or 4.0 ROM PET. The main advantage of the ROM Rabbit is that it doesn't have to be loaded each time you power up your PET and it does not occupy valuable RAM memory.

The PET RABBIT's high-speed cassette recording feature will not work with some of Commodore's older cassette decks. To be specific, cassette decks with the lift top lid (termed old style) will not work but all other features will work. In addition, we have discovered that some new style cassette decks will not work properly. How do you know if your cassette will work? Simple—open up the cassette deck and look at the printed circuit board components. If there are IC packages for all the active components, it will work with the RABBIT. If there are any transistors on the board, it will not work. Most new style cassette decks will work okay since there are very few of the transistor types. If you wish to purchase ROM RABBIT and a cassette deck, we can offer an attractive discount.

The RABBIT commands are:

SS — Save with short leader	D — Convert decimal # to hex #
SL — Save with long leader	H — Convert hex # to decimal #
L — Load a program	Z — Toggle character set
V — Verify a program	K — Kill the RABBIT
E — Load and then run	* — Go to monitor
T — RAM memory test	G — go to machine language program

RABBIT works with the PROGRAMMERS TOOL KIT.

CASSETTE RABBIT - \$29.95 EASTERN HOUSE SOFTWARE
ROM RABBIT - \$49.95 3239 Linda Dr.
(specify memory, 3.0 or 4.0) Winston-Salem, N. C. 27106

✓178

allow extensive control over processing activity. Price is \$1910. Reader Service number 490.



Syntest's dot matrix printer.

Printer for 12 V dc Operation

For the computerist on the go, Syntest Corporation, 169 Millhan St., Marlboro, MA 01752, offers the SP-314 dot matrix alphanumeric printer that operates on 12 V dc power, thus allowing complete independence from conventional power sources. This unit features buffered 40-column impact printing on 4.25-inch paper, RS-232 serial and parallel inputs, crystal-controlled baud rate, 96-character ASCII set plus double width and a self-test routine. This 8.5 × 5.75 × 8.5 inch unit weighs 5.5 lbs. and includes graphics capabilities. Price is \$605. Reader Service number 498.

Short-Length Cassettes

Microsette Co., one of the first companies to recognize the need for short-length cassettes in the microcomputer market, has added the C-60

and the C-90 length cassettes to its product line, which features the C-10 (50 ft.) and the C-20 (100 ft.) lengths already available. The C-60 measures 290 ft., and the C-90 is 435 ft.

Microsette Co., 475 Ellis St., Mountain View, CA 94043. Reader Service number 488.

Battery Backup for PET

Battery backup systems for the Commodore PET and Dual Disk Floppy Drive are available from ETC Corporation, PO Box G, Apex, NC 27502.

Backpack, designed to install within the CPU case, gives six to ten minutes of full power (CRT included) to the PET during power outages and glitches in power lines, allowing you time to save data or programs to disk or tape. Batteries are recharged from the PET's own internal power supply. Price is \$225.

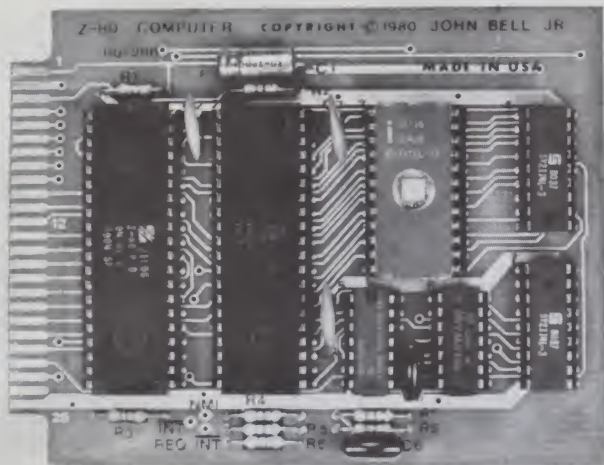
Floppy Backpack, used in conjunction with Backpack, gives 15 to 20 minutes of reserve power for both of Commodore's floppy drives. It allows you to save data and programs during power outages and also eliminates possible disk crashes. Designed to install within the disk cabinet with no wiring changes, the batteries are recharged from the disk internal power supply. Price is \$135. Reader Service number 494.

Z-80 Single-Board Computer

John Bell Engineering's Z-80-based single-board dedi-



Microsette's cassettes.



John Bell's Z-80 microcomputer.

cated computer, designed for control functions, is software-compatible with the Z-80, 8080 and 8085 microprocessors. This Z-80 microcomputer uses a Z-80 PIO chip that has two independent eight-bit bidirectional peripheral interface ports with handshake and data transfer control. It can be interrupt-driven. It uses one 2716 for EPROM memory and two 2114 RAMs and requires a single 5V power supply at 300 mA. Prices are \$129.95 (assembled and tested), \$119.95 (kit) and \$29.95 (bare board).

John Bell Engineering, PO Box 338, Redwood City, CA 94064. Reader Service number 489.

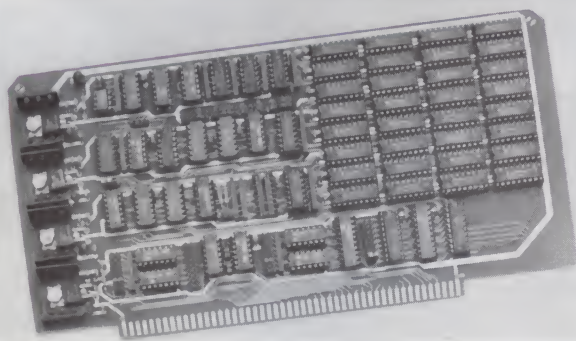
8/16-Bit Memory Board

The MB10, from SSM Microcomputer Products, 2190 Paragon Drive, San Jose, CA 95131, is a 4 MHz 16K static RAM memory board that fea-

tures extended addressing and IEEE-standard protocol. Extended addressing allows the use of multiple boards in the same configuration with as much as 16 megabytes of memory. For those applications requiring bank switching, the MB10 is jumper selectable to any I/O address with enable/disable on power-up or reset (Cromemco-compatible). Automatic 16-bit request and acknowledge protocol allows mixing 16-bit and eight-bit microprocessors in the same mainframe. It supports the new SSM CB2 Z-80 CPU board and will also operate an 8K-word RAM board for future 16-bit microprocessors. Price is \$399. Reader Service number 496.

Panel Meter-to-RS-232C Converter

The Model DPT-415 is a digital panel meter-to-RS-232C converter module that accepts parallel inputs and gen-



SSM's 16K RAM board.

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Digital Laboratories DPT-415.

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the module to be interfaced with a computer or directly to a printer having up to five readings per line. Operating on less than 2 watts, the 6 1/2 inch x 4 1/2 inch unit also has 20 mA current loop provisions to interface with Teletypes. Price is \$295.

Digital Laboratories, Inc., 600 Pleasant St., Watertown, MA 02172. Reader Service number 491.

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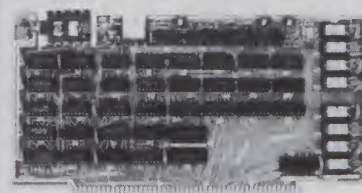
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PRICE. The General Ledger costs \$125.00; the complete IAS package (GL, AP, AR and PR) is \$350.00. The user's manual is \$20.00 (refunded with purchase). Since IAS is designed for the North Star DOS and Basic and will run in as little as 32K of memory, you don't need to buy more memory, a different operating system and Basic. This savings alone could pay for the software—and then some. You can pay a lot more, but shouldn't you check us out before you do?



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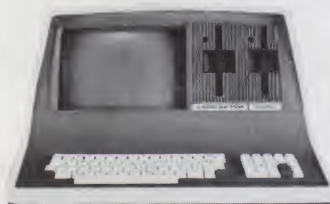
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Percom Data Company, 211 N. Kirby, Garland, TX 75042, is now offering an advanced speech driver and eight "talking" game programs for their Speak-2-Me-2 interface. The Speak-2-Me-2 printed circuit card installs in a Texas Instruments' Speak & Spell and, by providing the interface between the Speak & Spell and a computer, allows you to add speech to business and game programs. The Speak-2-Me-2 module and software are configured for TRS-80 Models I or III, but may be adapted for other computers.

The driver program provides a direct word output routine for outputting words and phrases of the Speak & Spell vocabulary and includes routines which will create new words using syllables of Speak & Spell words and a routine which will modulate the speed at which words are spoken. The game programs are speech-enhanced by vocal prompts and responses uttered at appropriate points during play. Included among the games are Hangman, card and dice games of chance and a challenging version of Simon Says. The driver routines and game programs are supplied on diskette for \$29.95. The Speak-2-Me-2 adapter sells for \$69.95. Reader Service number 478.

Ultrasort II

Ultrasort II gives CP/M and CBASIC2 users a fast 8080/

Z-80 machine-language program to sort, merge or select records from data files, or to find the number of logical records in a file. It can be used as a stand-alone utility or as a fast subroutine called from CBASIC2. This machine-language program handles large data files rapidly and will sort records thousands of bytes long. It sorts on up to five keys, each independently ascending or descending.

Fields may be variable or fixed length. The select capability lets you either omit or include records that are less than, equal to or greater than up to four independent select keys. The program also provides prompted disk changes for work and output files.

Computer Control Systems, Inc., 298 21st Terrace S.E., Largo, FL 33541. Reader Service number 475.

Tax-Planning Program

Shortax is a tax-planning program that enables professionals to forecast and analyze federal and social security taxes in just minutes, instead of hours. The program calculates federal income tax (using tax rate tables, income averaging formula, optional maximum tax method and the corporate alternative tax calculation for long-term capital gains), the add-on minimum tax, the alternative minimum tax, the FICA tax and the self-employment tax. It also forecasts positive or negative compound growth rates or constant incremental amounts for up to 99 periods.

Data files can be stored, retrieved, recalculated, modified, listed, added together, netted against each other or deleted with menu-prompting functions.

Data input, which is cross-referenced to tax forms with on-line instructions, consists of just 20 variables. Detailed instructions are available in response to "?" or "help" input. The program runs on most microcomputer systems which use a Micropolis Disk Operating System and a CPU with at least 48K of memory; it will also run on a Radio Shack Model I, Level II with 48K of CPU memory and one (or more) Radio Shack disk drives. Program price is \$500.

Syntax Corp., 4500 W. 72nd Terrace, Prairie Village, KS 66208. Reader Service number 481.

Z-80 Accounting Software

The Software Fitness Program, written in COBOL and run under the OASIS operating system, is a set of financial accounting applications for Z-80-based microcomputers. It is designed for small-business users and includes Sales Order Processing, Accounts Receivable with Billing and Sales Analysis, Accounts Payable, General Ledger, Inventory, Payroll and Job Cost. It will run on single- or multiple-user hardware systems supporting both disk and diskette storage. Software features include open item and balance forward accounting; LIFO, FIFO and average cost methods of inventory valuation;

single or multiple company processing; revenue and expense accounting by job or phase; and a report generator for financial statements. Interface switches can be set by the user to control the complexity of accounting interactions.

Open Systems, Suite 409, 430 Oak Grove, Minneapolis, MN 55403. Reader Service number 484.

Professional Software

Professional software packages to aid the dentist, attorney and consultant in appointment scheduling, professional time management, private client billing and management reporting has recently been released by CompuSoCo, 26251 Via Roble, PO Box 2325, Mission Viejo, CA 92690.

Professional I—for the dental professional—features preparation for ADA claim forms for third-party patients and notices for dental checkups.

Professional II—geared to the needs of the legal professional—features preparation of special reports for third-party legal plans and special accounting plans to analyze court time usage and work on retainer or contingency engagements.

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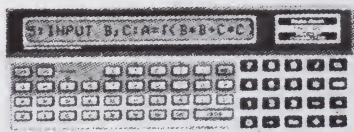
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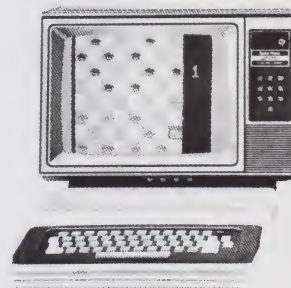
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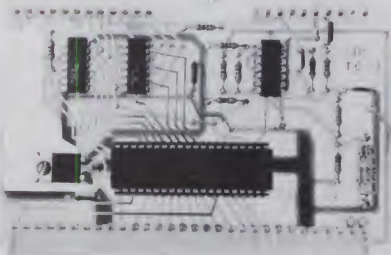
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It includes a magnification feature for dot-by-dot coloring and inverse coloring. Once painted, pictures can be saved or displayed in any combination of colors or in an unpainted state. Pictures can also be repainted at any time. Price is \$34.95.

Datasoft, 16606 Schoenborn St., Sepulveda, CA 91343. Reader Service number 471.

Intelligent Terminal Emulator

Cyber-Smart is an intelligent terminal program designed to communicate with mainframe computers and with other computers that have an RS-232 port. It features a fundamental set of communication routines capable of remote intelligent terminal emulation. The program can also be configured in a master/slave mode for computer-to-computer interaction.

The program is designed for expansion and personal modification in either BASIC or machine language. It uses less than 4K of RAM and can be configured for 8K, 16K, 24K or 32K systems. It is available for the OSI cassette-based C4P computer. Price is \$29.95. An RS-232 port installation kit is available for \$14.95. The combined soft-

ware/hardware kit costs \$39.95.

Cyber Associates, Inc., PO Box 4187, Dept. M, Huntsville, AL 35802. Reader Service number 474.

Atari Graphics Editor

Plot & Draw is a graphics package for the Atari that allows you to readily generate graphics in three colors, plus a background. You can create intricate video drawings and save them on cassette tape, where they can be retrieved later by your own computer programs. Single keystroke commands and the ability to combine pictures allow you to produce complex drawings. The program continuously displays its cross-hair coordinates for precision and flexibility. It comes on 8K cassette for Atari computers equipped with a joystick. Price is \$18.

Mosaic Electronics, Box 748, Oregon City, OR 97045. Reader Service number 472.

TRS-80 Income Property Analysis

Incoprop is an income property analysis program for the TRS-80 Models I or III. Designed for real-estate brokers, sales people, counselors, educators, students and investors, the program is based upon standardized methods of property analysis used throughout the real-estate industry. It generates a property operating statement and a ten-year cash flow analysis. The use of a built-in IRS tax table ensures high accuracy of an investor's projected after-tax income stream. Minimum system requirements include 32K RAM, one disk drive and a printer. Price is \$120.

E-Z Software, PO Box 591, Novato, CA 94947. Reader Service number 482.

TRS-80 Accounts Receivable

AR, an accounts receivable system for the TRSDOS 1.2 on TRS-80 Model II, is a complete invoicing and monthly-statement-generating system which keeps track of current and aged accounts receivable.

AR enables you to speed collections and spot potential losses early enough to take action. This package maintains a file consisting of the customer's name, address and phone number, along with the customer's type of account (open item, balance forward or auto billing), current balance, tax rate and other useful account status information. It uses a full 80-column screen and requires 64K memory and dual disk systems. Price for the eight-inch diskette program is \$129.

Micro Architect, Inc., 96 Dothan St., Arlington, MA 02174. Reader Service number 476.

6502 Disk Operating System

DOS/65 is an operating system for the 6502 family of processors. It uses a layered structure like CP/M so that each user's peculiar hardware and software environment can be accommodated with minimal effort. System requirements include an eight-

inch IBM-compatible drive and controller, a console input device and a console output device, as well as a minimum of 16K to 24K RAM, depending upon the host system. In addition to the basic operating system, the diskette contains a disk file text editor, a disk-based two-pass assembler, a debugger, a system generation routine and other transient utilities.

Richard A. Leary, 1363 Nathan Hale Drive, Phoenixville, PA 19460. Reader Service number 483.

North Star Z-80 BASIC

Now the North Star Horizon can execute programs 25-30 percent faster with Bazic, a software package with all the same functions, as well as several additional features, provided by North Star BASIC. Written in Z-80 code, Bazic features increased speed and more compact code, requiring less memory than BASIC. Bazic simplifies pro-

gramming with the use of APPEND as a command or as an executable statement in a program. It also provides functions to assist in screen formatting. The Bazic version using North Star DOS as the disk operating system is available on 5-1/4-inch disk for North Star double-density/quad-capacity systems for \$150.

Micro Mike's, Inc., 905 South Buchanan, Amarillo, TX 79101. Reader Service 479.

Instructor Gradebook for the Apple II

Now educators at every grade level can record and report individual and class performance for classes of up to 400 students and statistically measure the effectiveness of teaching and evaluation techniques with the Instructor Gradebook from Serendipity Systems, Inc., 225 Elmira Road, Ithaca, NY 14850. Designed for the Apple II Plus or

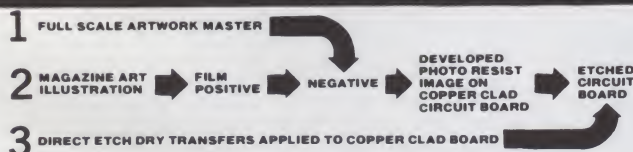
the Apple II with Applesoft firmware, Instructor Gradebook offers seven defined and two optional grading categories (e.g., test, homework, quiz). Marks can be entered either as numbers or as letter grades. Reports available include alphabetized class lists, grade listings by student ID numbers for posting individual performance reports and permanent class records. Price is \$169. Reader Service number 477.

Business Graphics For the Apple

Trend-Spotter is an easy-to-use business graphics and analysis for the Apple II Plus computer. It allows you to spot emerging trends through quick manipulation and graphing of business data. It will generate and read VisiCalc-compatible files. Price is \$275.

Software Resources, Inc., 44 Brattle Street, Cambridge, MA 02138. Reader Service number 473.

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COMPUTER CLINIC

I have recently changed my CPU computer board from an 8080A to a Z-80 and now find that my Altair Extended BASIC will not run. Does anyone know of a "patch" to Altair BASIC which will allow it to run on the Z-80?

George R. Steber
9957 N. River Road
Mequon, WI 53092

I need schematics and service data for a Tektronix 31 calculator and Tektronix 4661 digital plotter. Attempts to get this information from Tektronix have been unsuccessful.

Kenneth H. Reid
1935 Trevillian Way
Louisville, KY 40205

I need a BASIC interpreter (preferably 8K or larger) on Tarbell cassette suitable for use with an Imsai 8080. I also

want the source code listing, if available. Since I live in Saudi Arabia, where computing materials are unobtainable, any help would be much appreciated.

Richard Herman
c/o Donald Herman
Thor Johnson Dorm
Interlochen Arts Academy
Interlochen, MI 49643

I have acquired two eight-inch single-sided disk drives, which, I believe, might be IBM and are marked "33FD," but I have no data on them. I would be grateful if any reader of *Microcomputing* could assist me with any relevant data—particularly details of the pin-outs from the 24-pin connectors on the side of them.

Rory O'Farrell
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CLUB NOTES

Hamilton, Ontario

The OSI User's Group of Southern Ontario will hold its next meeting on Saturday, March 7, from 10 a.m. to 4 p.m., at McMaster University, General Sciences Building, Room 312. Meeting dates for the remainder of 1981 are June 6, September 5 and December 5. For more information, contact Dr. N. Solntseff or C. Bryce, Unit for Computer Science, McMaster University, Hamilton, Ontario L8S 4K1, 416/525-9140, ext. 4689 or 2065.

Delaware Valley

Computer owners of the Delaware Valley should note the existence of the TRS-80 User's Group of Delaware. Contact Tim, 302/478-7415; Merle, 302/366-0785; or Al, 302/762-4223.

Rochester, NY

The Rochester Area Microcomputer Society will hold its third annual spring computer show on April 4 at the Perinton Square Mall, corner of Rts. 250 and 31, Fairport, NY, near Rochester. For further information, contact the Rochester Area Microcomputer Society, PO Box 90808, Rochester, NY 14609, or call Erwin Rahn, president, 716/473-3184.

New Orleans, LA

The Texas Instruments Minicomputer Information Exchange (TI-MIX) will hold a conference for users of Texas Instruments computer equipment on March 8-11 at the Marriott Hotel in New Orleans. Further information is available from TI-MIX, PO Box 2909, Austin, TX 78769, 512/250-7151.

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Howard W. Sams & Co., Inc.
\$8.95

Don Lancaster is a capitalist's capitalist. He fully understands the concept that to make money, you must find ways to not spend money. The result of Lancaster's capitalism has been a series of "you-build-it" hardware books. The latest in the series is *Son of Cheap Video*, a sequel to *The Cheap Video Cookbook*, a volume of video hardware fixes and modifications for the hardware freak.

In *The Incredible Secret Money Machine*, Lancaster asserts that the secret money machine is you, and your willingness to put your micro to work either by writing programs, taking care of the statistics for a local bowling league or designing hardware modifications that can make a microcomputer do more for less. In *Son of Cheap Video*, he is, once again, practicing what he preaches.

The concept of cheap video is simple—find new ways to get the output of a microcomputer onto an ordinary TV screen. This is done with a minimum of hardware and without major modifications to either the computer or the TV. Lancaster calls this concept "scungy video."

The advantages of scungy video, designed primarily for the KIM-1 and other 6502-based systems, are many. You can eliminate most of the address restrictions that cheap video imposes on your micro; scungy video techniques eliminate much of the interaction between the computer and the video circuitry, making the video hardware a mere add-on to the system; and you can eliminate one or both of the custom PROM memories used in cheap video.

Scungy video works by adding two new elements to the software scan microinstruction and hardware upstream tap that are the keys to cheap video. It eliminates the subroutine address space mapping used in cheap video and uses break

mapping for the scan microinstruction instead. Also, scungy video uses available parallel I/O ports to decrease special hardware needs.

With cheap video and scungy video, complex systems timing and separate display memory are not needed, because the system lets the computer do the work on a time-sharing basis with the programs in memory. The net result of these modifications is a video display system that can be built for as little as \$7.

And that's just the beginning. *Son of Cheap Video* will also show you how to achieve full transparency, which lets you compute and display at the same time. All it takes is a length of wire (used to make a sensor coil) and an extra CMOS gate. This new route to transparent cheap video is called the "snuffler" method. Or, if you need to deliver a message in Swahili, using Icelandic characters, *Son of Cheap Video* will show you how to generate custom characters and graphics. As an example of what you can do with the character generator, chapter 4 shows you how to put together a music display with a music staff; whole, half, quarter, eighth and sixteenth notes; measure symbols; treble and bass clefs and more.

Son of Cheap Video doesn't forget the 8080/Z-80 crowd, either. There are adaptations of cheap video for the Heath H8 on the hardware and software sides. In a similar vein, there are two chapters detailing a hardware/software modification to add lowercase capability to the Apple II. This lowercase modification uses the existing keyboard, and you add only two new ICs and a plug-in module. No foil cuts or PC board changes are necessary. Lowercase for the Apple is the crowning touch to this volume of high-tech fixes for the low-budget fixer and, by itself, justifies the purchase price of the book.

The book is profusely illustrated and contains the kinds of circuit diagrams that almost anyone can read. The information is accessible, and Lancaster's breezy style is often good for a chuckle or

two. There are armfuls of information packed on every page.

Don Lancaster knows that tomorrow's hardware innovators are today's low-budget hobbyists, and he has designed this and his other books to teach and encourage that audience of hardware bashers. As Lancaster warns in his introduction, "If you are not one of us, go away."

G. Michael Vose
Instant Software
Peterborough, NH

Principles of Interactive Computer Graphics

Second Edition
William M. Newman and Robert F. Sproull
McGraw-Hill, Inc., 1979
\$26.95

For anyone wishing to learn about computer graphics, *Principles of Interactive Computer Graphics* is the place. This book gives both comprehensive and detailed coverage of the current state of the art. And for a field as broad as computer graphics, that's an impressive achievement.

The book is broken into six sections: Basic Concepts, Graphics Packages, Interactive Graphics, Raster Graphics, Three-Dimensional Graphics and Graphics Systems. Basic Concepts is a brief overview of the hardware and software involved in displaying pictures on a screen. The organization of this section is typical of the rest of the book: it goes from easy (points and lines) to difficult (transformations, clipping, windowing). Nevertheless, the writing is clear and it is easy to skip around difficult or uninteresting sections without getting lost in the sections ahead.

Graphics Packages is about display files—how they are organized, constructed, compiled and used to represent geometric models and pictures. The hardware on which the discussion is based is often

available to university students, but is older and more expensive than what a home computer user is likely to have. Nevertheless, the importance of organization and structure in the design of graphics systems makes these chapters relevant, regardless of what hardware you are working on.

Interactive Graphics is where things start to get interesting. It starts out with descriptions of graphical input devices, including light pens, joysticks and the SRI mouse (some are available commercially and some are not). Then it introduces the software techniques for handling them and strategies for making effective and comfortable use of them. If you've never seen what kind of programming is necessary to make these devices work, you'll find this section most enlightening.

Raster Graphics is the section of the book most relevant to microcomputer users. It is about the use of the type of graphics hardware most often found on microcomputers, bit-mapped video displays. The descriptions of the hardware operation and the general-purpose algorithms are directly useful for developing graphics software on microcomputers. (All of the algorithms in the book are presented in Pascal.)

Three-Dimensional Graphics contains some of the most difficult reading in the book. There is no way to cope with the problems of translation and rotation of three-dimensional images without using a lot of mathematics. It is not especially difficult mathematics, and this is as good an explication of it as any, but be prepared. (Two technical appendices introduce the necessary concepts of matrices and coordinate techniques, but you can't learn these subjects from appendices.) The last section, Graphics Systems, brings together much of the technical material in the book and discusses the design of graphics hardware and, most importantly, user interfaces.

Together, these six sections form a rich source of information from which to draw while studying computer graphics. The book includes a good index and an extensive bibliography (over 500 entries) to help you find more details on any of the subjects covered in the text.

Be sure to get the second edition. The first edition is ten years old and is somewhat out of date (it has no discussion of raster graphics, for example). Also, it is only in the second edition that all the sample algorithms are presented in Pascal; the first edition used SAIL, which is not widely known.

As with all hardcover technical books, the price is something else. If you are not sure that you need a really technical overview of the field, try a nearby library and look it over first. But if you are serious about computer graphics, this book is a necessity. Consider the price cheap when compared with all of the expensive

hardware it will help you make better use of.

Richard Fritzon
Buffalo, NY

Microcomputer Interfacing With the 8255 PPI Chip

P. F. Goldsborough

The Blacksburg Continuing Education Series
Softcover, 217 pp.

Available from Group Technology, Inc.,
PO Box 87, Check, VA 24072, for
\$9.95 postpaid.

If you are considering using an LSI programmable I/O chip and want to know more about its application and theory of operation, or if you are currently using an Intel 8255 in your system but want more flexibility from the chip than simply three ports of eight bits each, then this is the book you need.

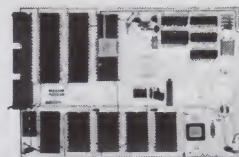
If your system can be configured to allow experimentation, the book includes 17 experiments which can be executed by an 8080-based system. Complete program listings (in 8080 assembly language) and circuit diagrams are given for each experiment. Accompanying each experiment is a host of questions, as well as tests for specific results, which test the reader's comprehension of the experiment and the results achieved. The chapter-end experiments reinforce material covered. Some familiarity with digital electronics, microcomputer interfacing, TTL circuitry and solderless breadboarding techniques is assumed.

Since knowledge of I/O techniques, whether accumulator or memory-mapped, is essential to understanding how any interface chip works, both methods are reviewed in chapter 1. Goldsborough discusses characteristics of both techniques and the advantages and disadvantages of each. The experiments in chapter 1 familiarize the reader with a bus monitor, single-step circuit for an 8080 system, a method of counting different types of synchronizing pulses and accumulator versus memory-mapped data input.

Chapter 2 presents an overview of the PPI (programmable peripheral interface) and establishes the basis for the final five chapters. The three modes of operation are explained briefly. The book gives a block diagram of the PPI and covers the various interface signals required by the PPI and generated by the 8080. The PPI internal control logic is discussed in a manner which leaves no doubt how each bit in the mode control byte affects the mode configuration of the PPI. The author gives steps for interfacing the PPI to an 8080 for both accumulator I/O and memory-mapped I/O. Numerous flowcharts supplement the software examples, which helps the readers not familiar with the 8080 assembly language.

Mode 0, or "simple I/O," is covered in

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CSIO-5 Input/Output provides ROM-able, self-relocating driver routines for parallel ASCII keyboard and 1801 character output. CRT capability for your programs, in a "black box" Needs 2K (5 pages RAM/ROM for code, 3 pages RAM for screen stack). \$27

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STARSHIP by John R. Powers, III, is a fascinating space game which provides captivating fun for all ages (even if you hate games!) Warning: you might not want to return to Earth! Needs 4K and hex keypad; joystick and soundboard are optional. Game tape and manual, \$9.95; separate assembled source listing is \$14.95

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chapter 3, which deals exclusively with "unconditional" or "asynchronous" data transfer without handshaking. Various methods of configuring ports A, B and C are discussed. Examples throughout the book illustrate why a particular port configuration might be required. A program and timing diagram follows a section on how to configure the PPI for mode 0 I/O. Port C usage is illustrated with a block diagram, a subport allocation table and two programs. References precede the three experiments. A number of tables in the chapter are handy for reference.

Chapter 4 discusses and illustrates in great detail the PPI bit set/reset capability of port C in mode 0 operation. The reader is given an appreciation for the real-world interface capabilities of the 8255 by an application example.

Status-driven handshaking I/O with combined mode 0 and bit set/reset operation is covered in chapter 5. Handshaking is explained in words and diagrams, and contrasted to interrupt-driven systems in the same manner. Flowcharts are used to excellent advantage in explaining implementation of status-driven handshaking I/O. The interfacing example given in this chapter is a paper tape punch and reader. The experiment covers the subject matter in very good detail. The program examples and circuit diagrams are, as always, given in sufficient detail to let the reader wire-up the circuit and execute a working program without having to guess what the author had in mind and why it doesn't work.

Befitting the subject matter, interrupt-driven handshaking I/O, chapter 6 is the longest (52 pages) and most involved chapter. Since interrupt-driven systems are inherently complex, Goldsborough gives extensive attention to system timing considerations, interrupt service routines and associated hardware. Numerous illustrations explain the internal sig-

Program Conversions

Have you made any conversions lately? If so, *Kilobaud Microcomputing* wants to hear about them.

We're talking, of course, about converting programs found in the pages of *Kilobaud Microcomputing* for use on your system. Many fine programs have been published in the magazine, but they are of little use to you if they aren't compatible with your system.

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nal handling of mode 1 input and output operations. The book includes an example of a fully decoded keyboard and a video display, discusses the signal requirements and provides a program listing.

Concluding the example is a discussion of a design approach to using a PPI for mode 1 handshaking I/O. The discussion consists of guidelines that the reader should consider when designing a mode 1 PPI interface for any use, not just a keyboard and display. The five experiments are very comprehensive. As usual, schematics are given, in-depth questions are asked and the answers provided. Also, timing diagrams aid in comprehension.

Mode 2 (bidirectional I/O) operation is covered in chapter 7. The concept of master and slave CPUs is illustrated in this chapter. The discussion includes block diagrams, timing diagrams, operational sequence of events tables (those are invaluable to understanding the material), flowcharts and program examples. As always, the programs are well-documented to aid in understanding program flow.

The experiment illustrates the use of two 8080 microcomputers interfaced for bidirectional I/O, and shows the sequential transfer of data from the master to the slave and back. Unless you have access to another 8080-based system, merely reading the experiment must suffice. That is not to say, however, that nothing can be gained from the experiment if you don't happen to have an extra system. As with the other experiments, the reader can follow, and probably learn from, the experiment simply by reading the programs, circuit and timing diagrams and answering the questions.

Two appendices cover electrical characteristics and timing diagrams for the PPI and the 8255 control word and status word formats. I found that even with the PPI status and control word information included in appendix 2, it was convenient to dog-ear pages that explain the various format combinations. As with most other Sams books I've read, the index leaves something to be desired, although this one is better than most.

Although I thought I was familiar with the PPI operation, I learned quite a bit from the book. Even if you don't use an 8255 in your system, the material is presented in such a manner that you'll gain a familiarity with programmable peripheral interfaces. If you are designing an interface, you should be able to reduce the hardware complexity (and probably ease programming, too) after reading the book.

The book was well-written and well-composed. The examples and experiments not only reinforced the text, but also let the reader do some self-testing. To that end, the questions were for the most part in-depth enough to make the reader think further about the material.

J. C. Hassall
Blacksburg, VA

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